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## Concept Of The Month

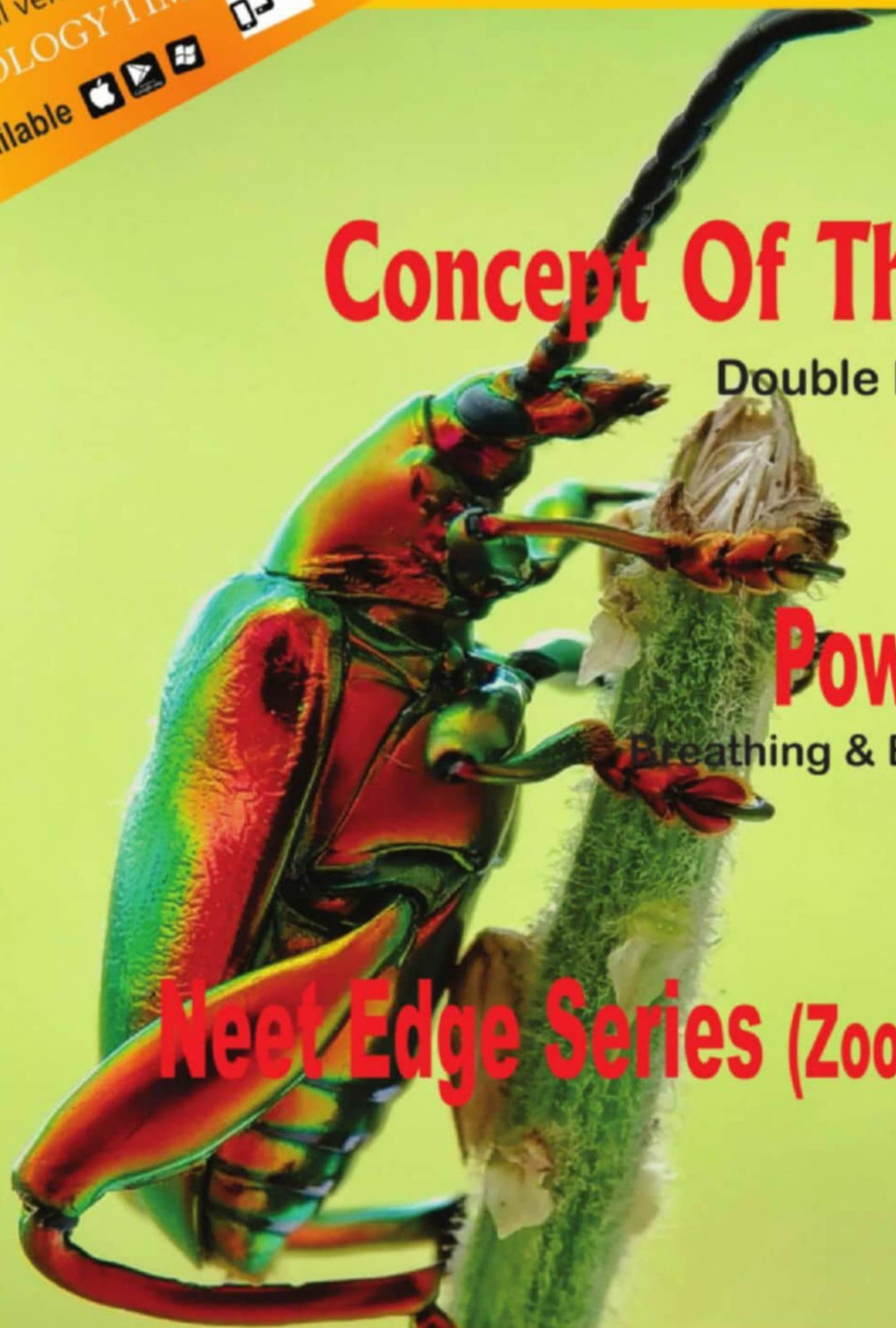
Double Fertilization

## Power Drive

Breathing & Exchange of Gases

## Neet Edge Series (Zoology & Botany)

## Previous Year Questions (NSEB/NSEJS/NTSE/KVPY)





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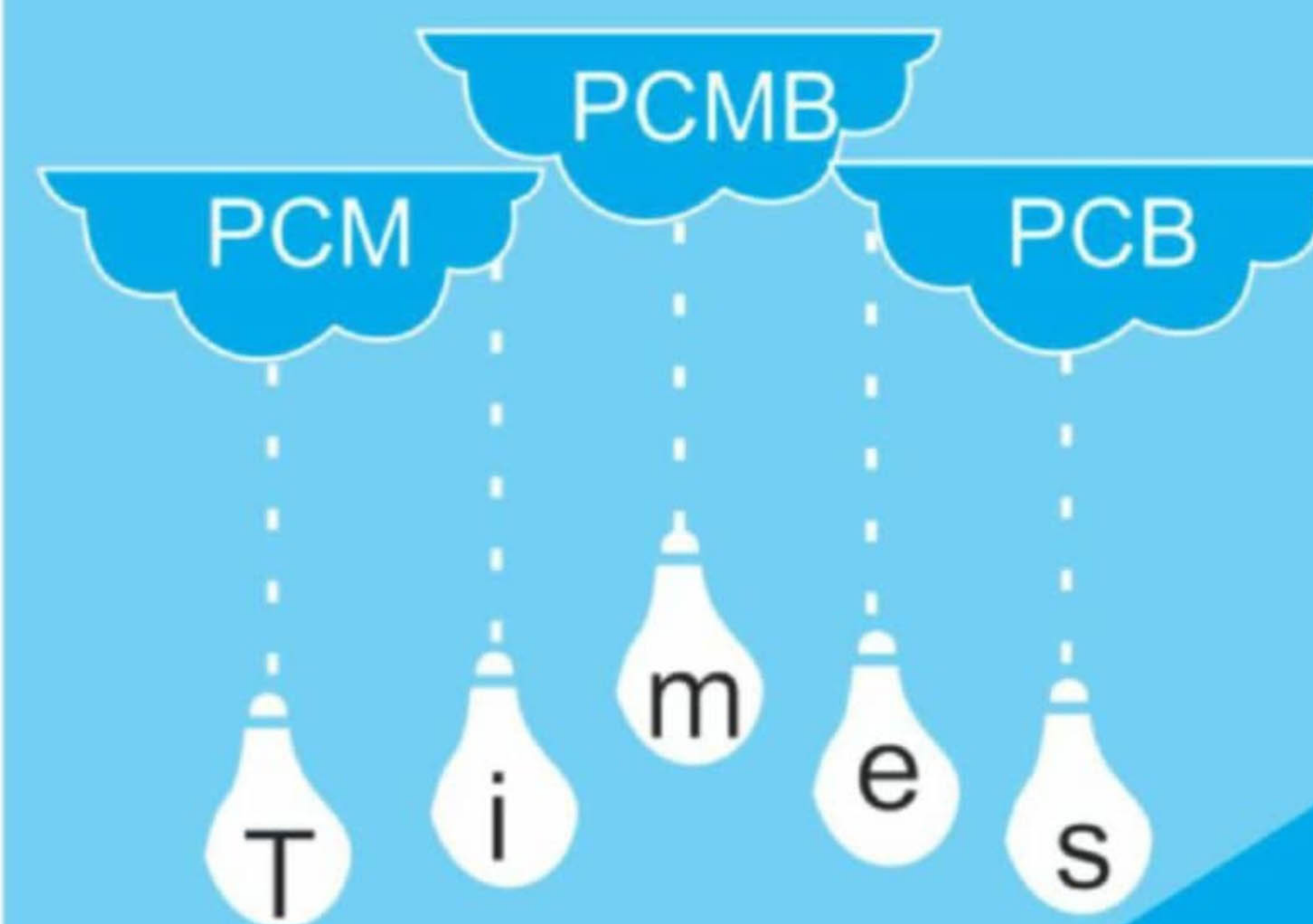
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# Double Fertilization

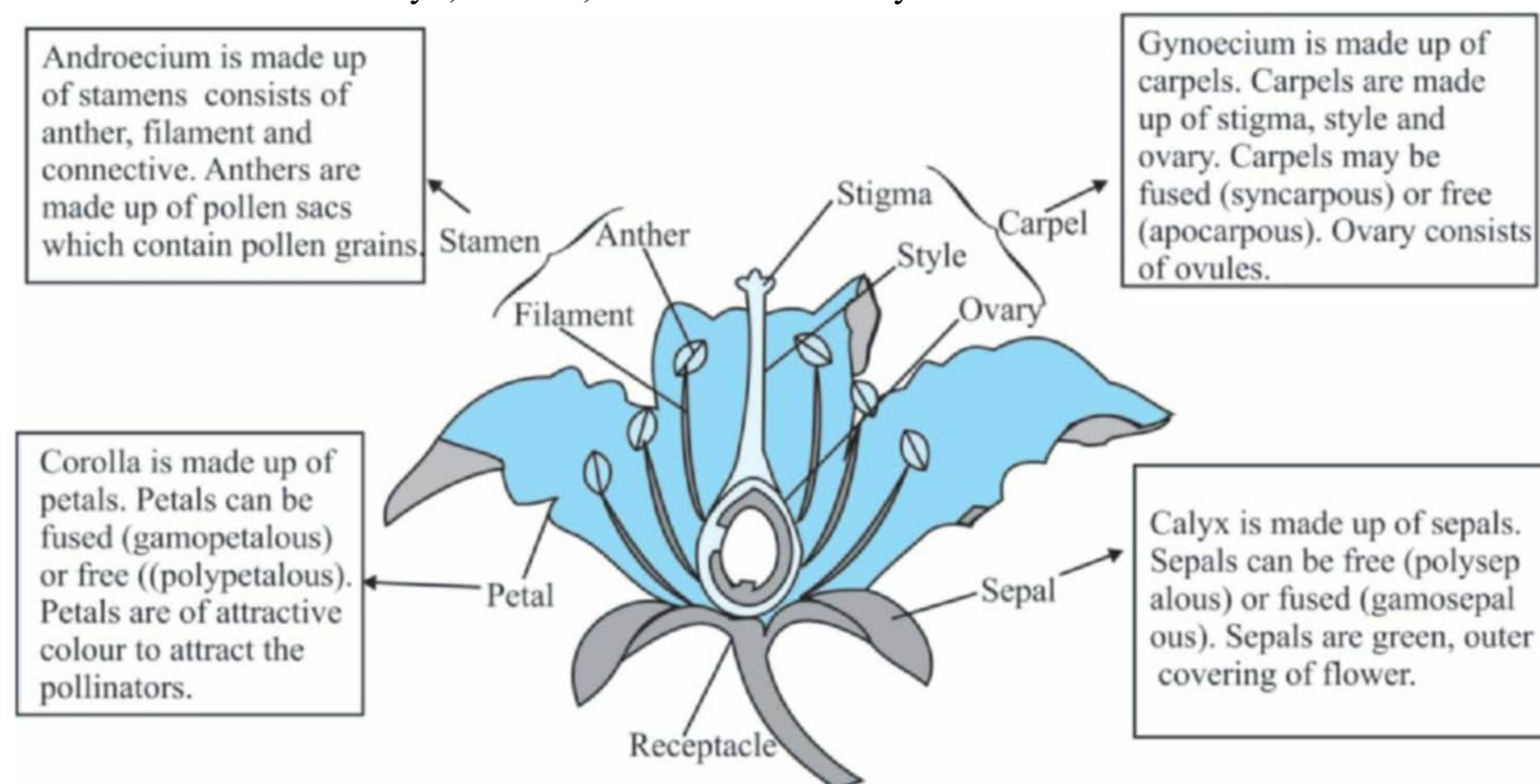
## Concept of the month

This column is aimed at preparing students for all competitive exams like AIIMS, NEET, JIPMER etc. Every concept has been designed by highly qualified faculty to cater to the needs of the students by discussing the most complicated and confounding concepts in Biology.

By: Keshav pai (Mangalore)

### Introduction

Sexual reproduction is a type of reproduction which includes formation of young ones by fusion of gametes. Angiosperms consists of specialized part for sexual reproduction known as flower. Flower consists of Calyx, Corolla, Androecium and Gynoecium.

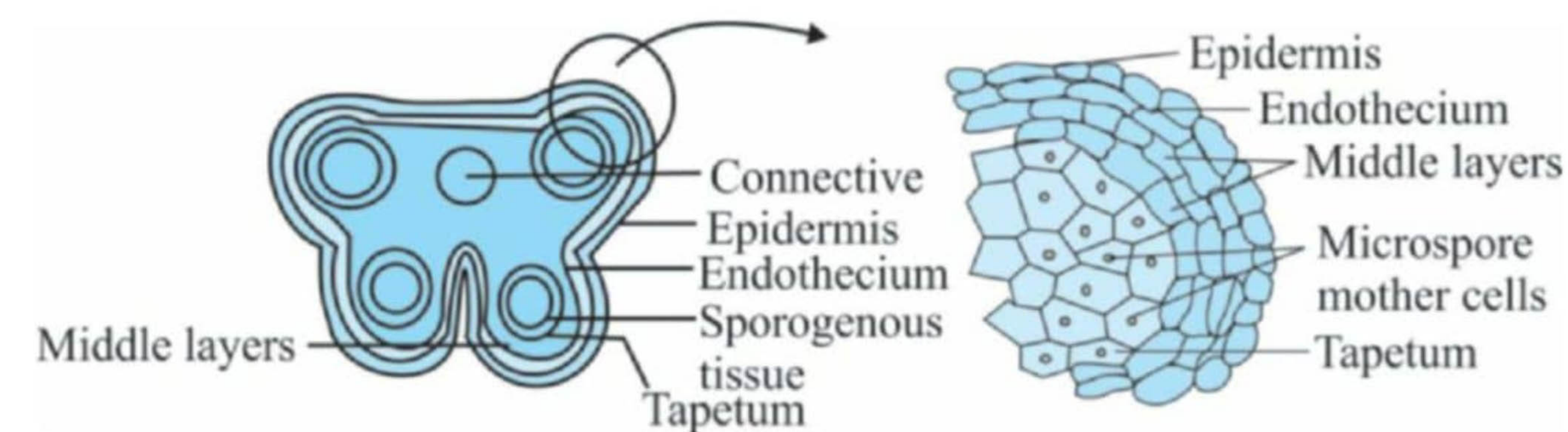


### Pre – Fertilization Events

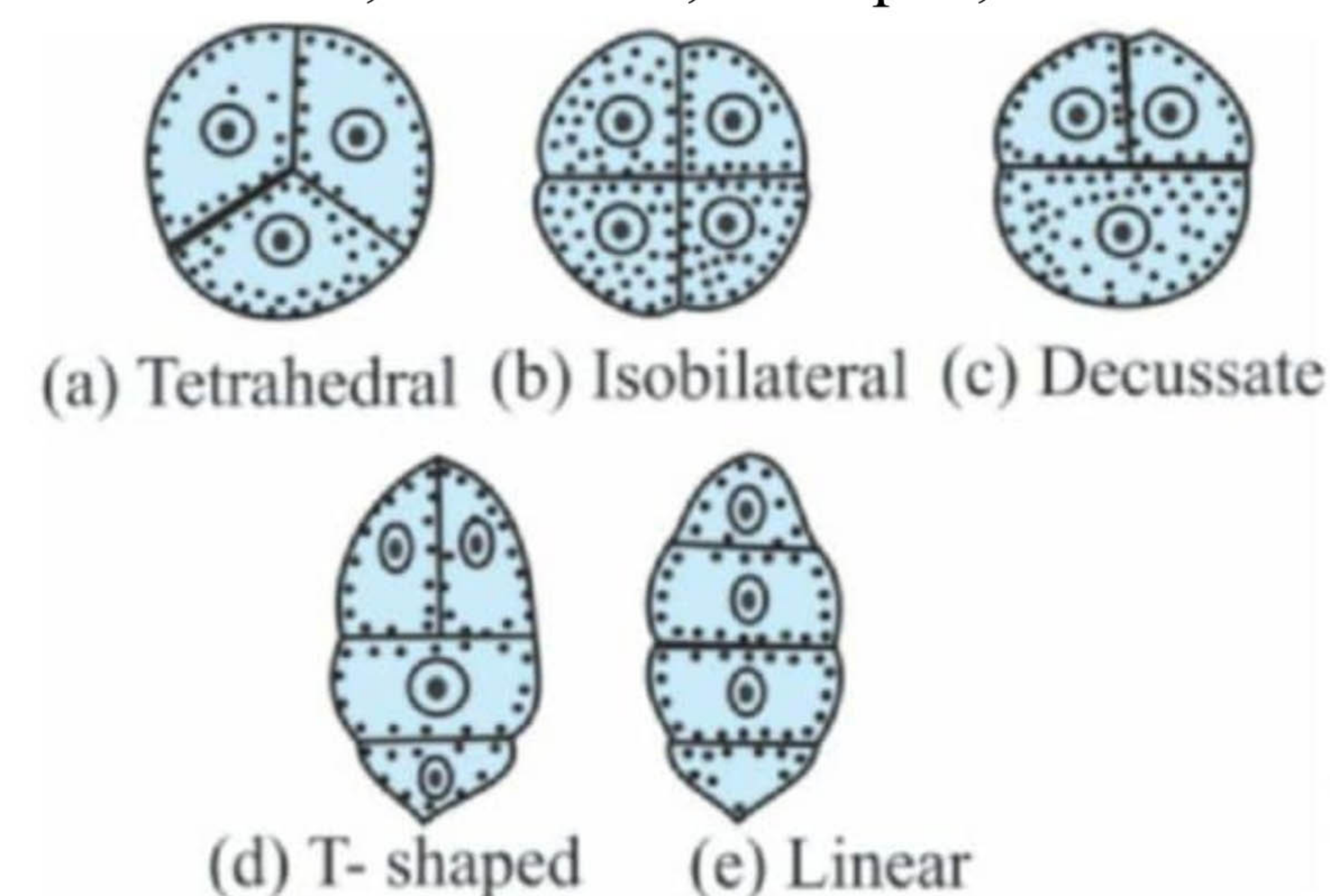
It includes all the events prior to the fertilization i.e. sporogenesis, gametogenesis and pollination.

#### Microsporogenesis

- The process of formation of microspores from a pollen mother cell through meiosis is called **microsporogenesis**. A typical anther is a tetrasporangiate where the anther is bilobed and consists of four pollen sacs. The anther develops from a homogeneous mass of hypodermal cells. Hypodermal cells get differentiated into archesporial cells. These cells contain a prominent nucleus and abundant protoplasm. Archesporial cells divide periclinally and produce outer parietal cells and inner sporogenous cells. Parietal cells divide anticlinally and form 2-5 layers: Epidermis, Endothecium, Middle layers, and Tapetum. Epidermis is protective in function. Endothecium helps in dehiscence. Tapetum cells are nutritive in function.

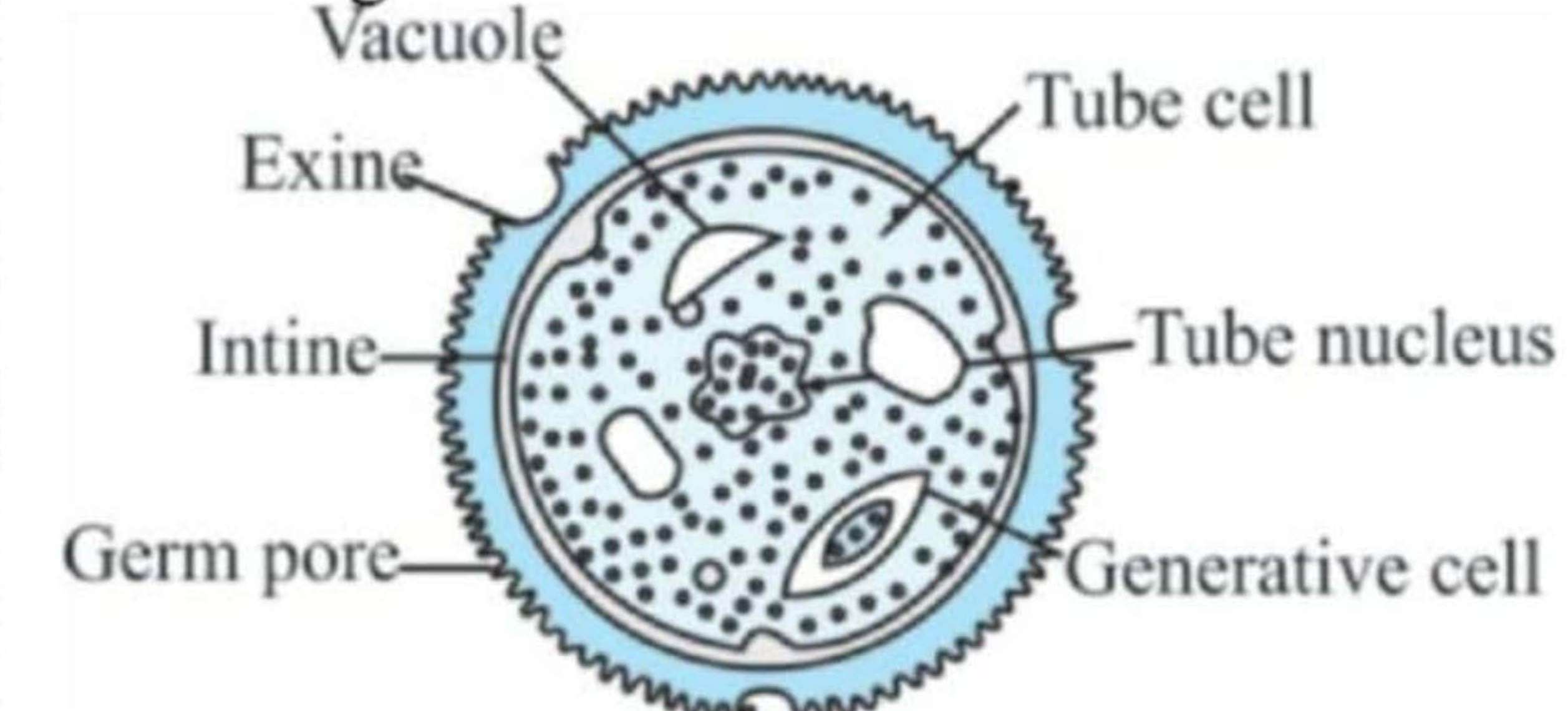


- Each cell of Sporogenous tissue is capable of giving rise to a microspore tetrad, and each one is a Pollen mother cell (PMC) or microspore mother cell (MMC).
- Pollen mother cell (PMC) or microspore mother cell (MMC) undergoes meiosis to give rise to pollen tetrads, which may be of different types, namely Tetrahedral, Isobilateral, Decussate, T-shaped, Linear.

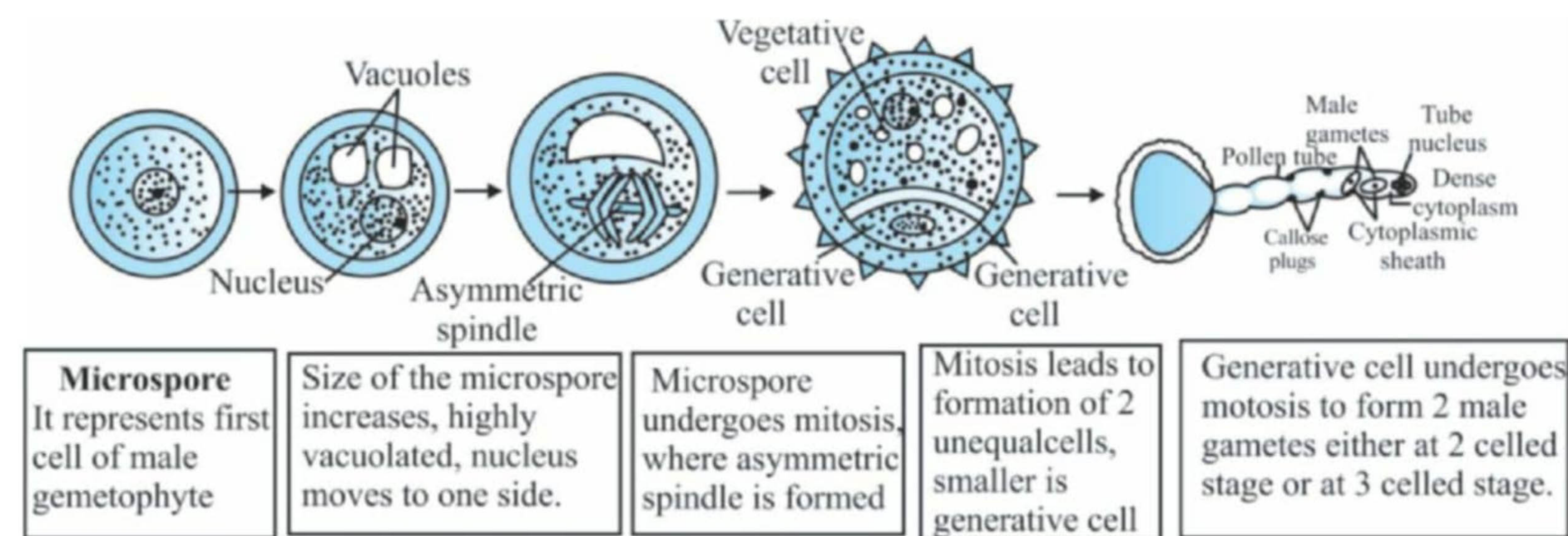


- Pollen tetrads are held together by callose, which is later dissolved by the callase enzyme, leading to the separation of microspores.
- During this period, spherical bodies are formed

inside the tapetal cells before disintegration. These spherical bodies are called as Ubisch bodies. Ubisch bodies are mainly made up of sporopollenin. After the formation of Ubisch bodies, the tapetum layer degenerates. Ubisch bodies participate in the formation of the exine of the microspores inside the pollen sacs. Thick-walled microspores are called as Pollen grains.



- As the anther matures and dehisces, it dissociates and develops into pollen grains.
- A pollen grain has two layers: the outer exine and the inner intine. The exine is sculptured and made of sporopollenin (resistant to temperature and chemicals, which makes pollens remain preserved).



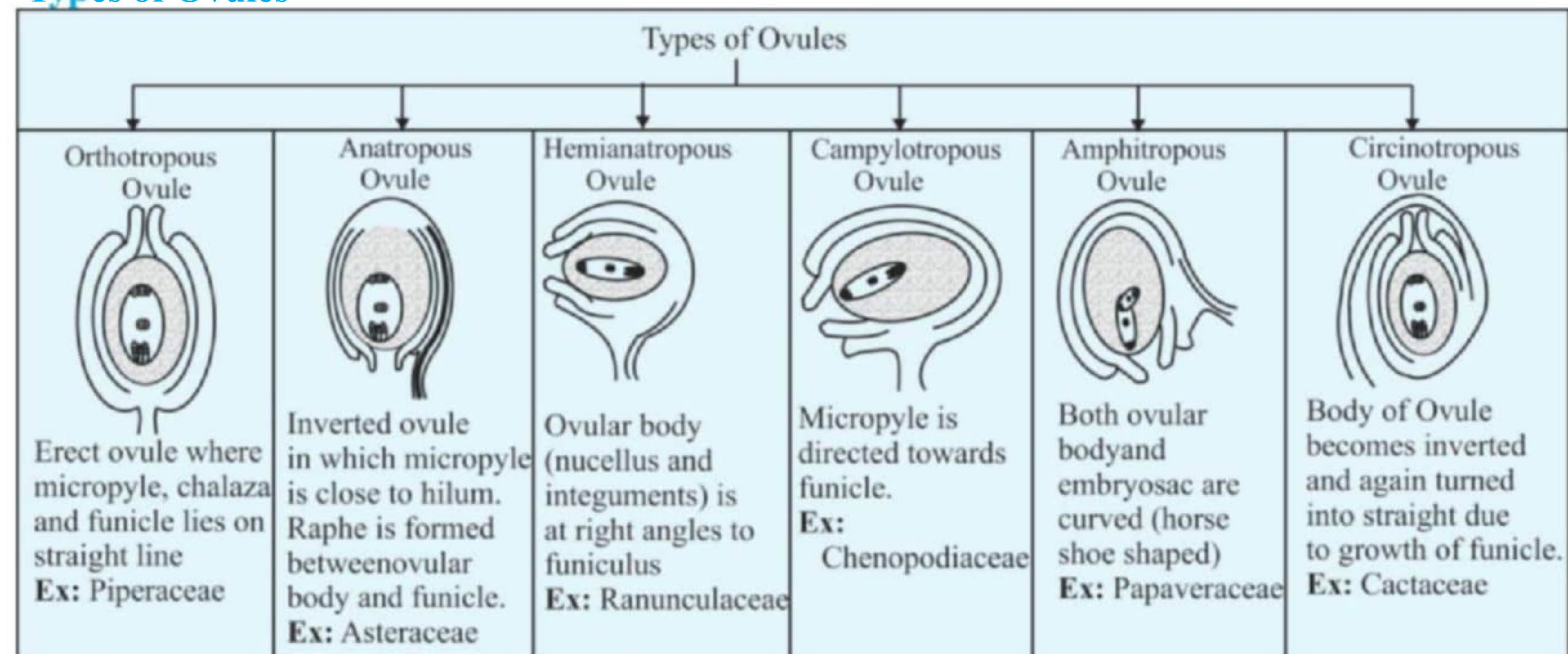


- At certain places exine remain thin and those areas called as germ pore. Sporopollenin is highly resistant material and non-biodegradable. Intine is made up of pectin and cellulose or pecto cellulose. Pollen grain mitotically divide and forms bigger vegetative cell and smaller generative cell.
- Vegetative cell has large nucleus and dense cytoplasm. In 60% of angiosperms, pollen shed at 2 celled stage. In remaining species, generative cell divides mitotically to give rise to 2 male gametes. Pollen grains are rich in nutrition. Pollen tablet and syrups are used as food supplement by athletes and by horses. Pollen of *Parthenium* is also a major cause of allergy.

### Megasporogenesis

- It is the process of formation of megaspores from megaspore mother cell. Gynoecium contains carpels. Each carpel contain Stigma, style and ovary. This process takes place in ovary especially in ovules.
- Ovule is an integumented megasporangium found in spermatophytes which develops into seed after fertilization. Each ovule is attached to the placenta by a slender stalk called **Funicle**.
- The point of attachment of the body of ovule with funicle is called **Hilum**.

### Types of Ovules



Based on number of integuments, ovules are of 3 types

- Ategmic Ovule**: Nucellus is not surrounded by integuments. Ex: *Loranthus*
- Unitegmic Ovule**: Nucellus is surrounded by one integument. Ex: *Helianthus*

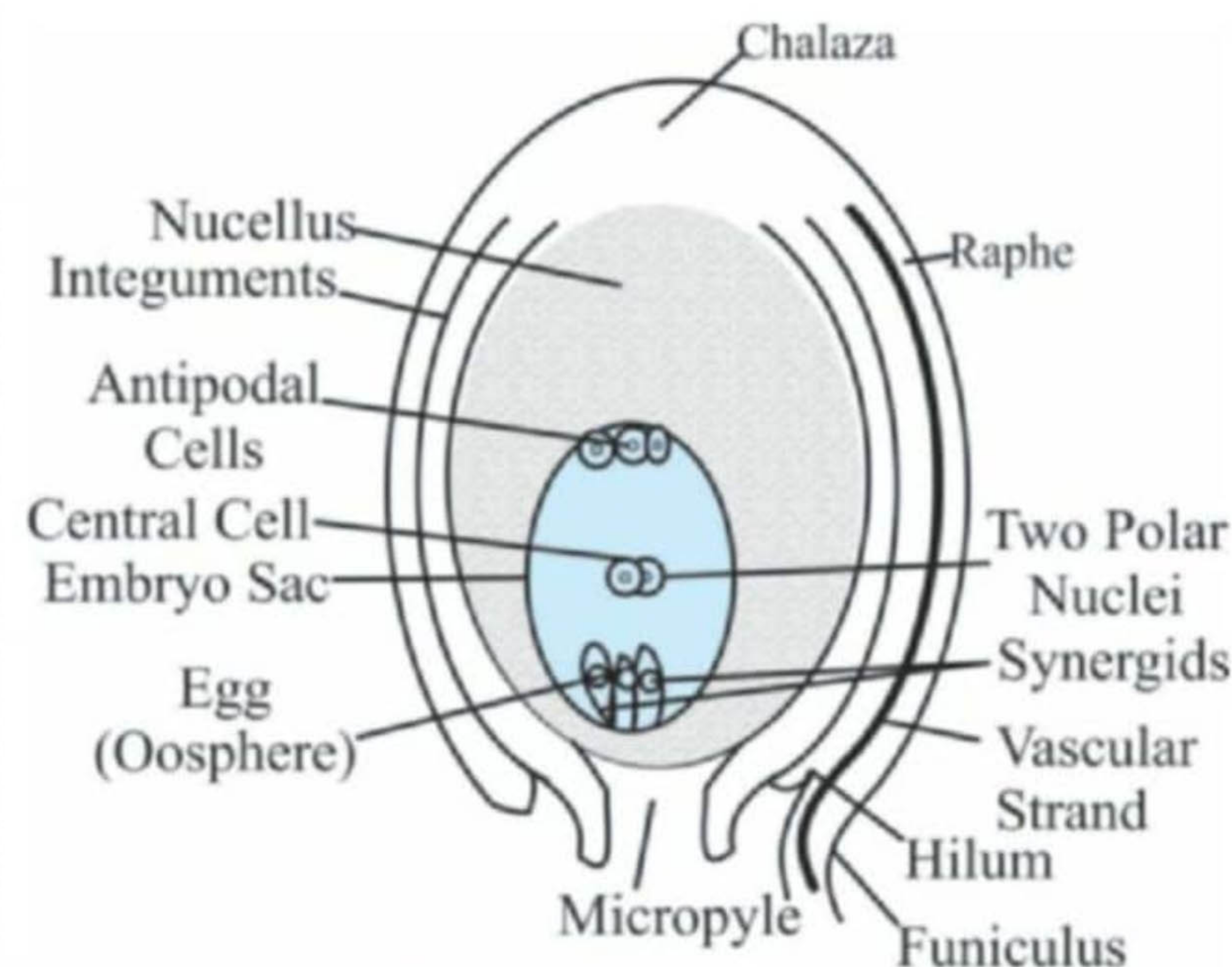


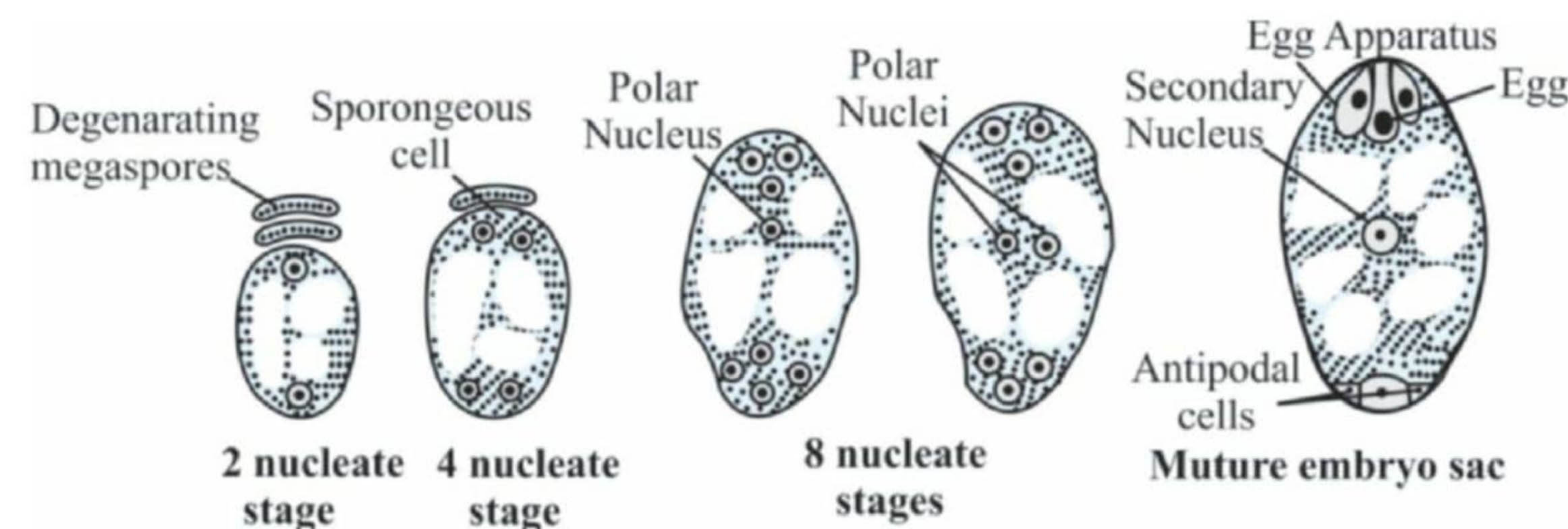
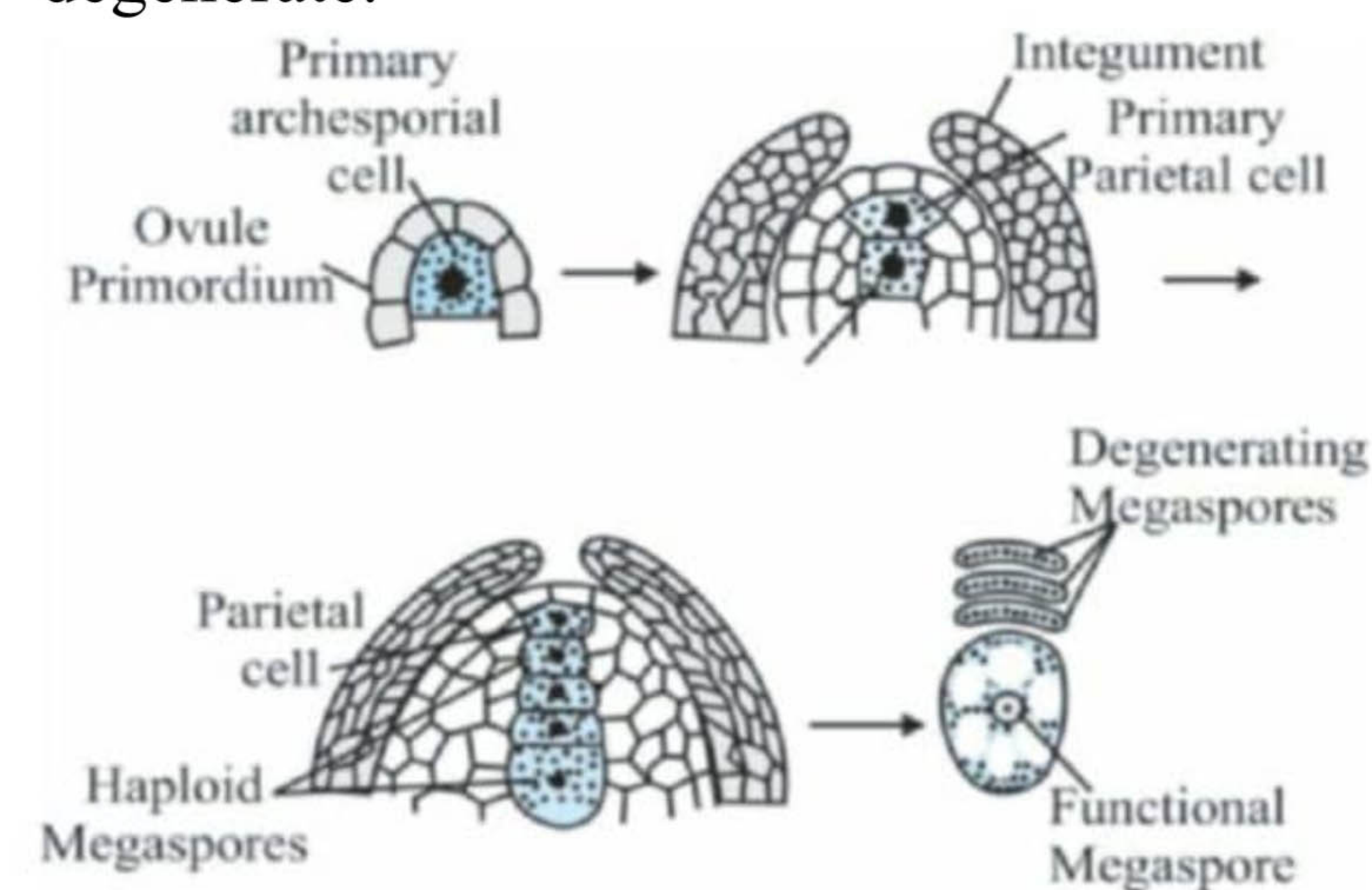
Fig: V.S. of Anatropous ovule

- In a typical ovule, funicle is fused with body of ovule beyond hilum. It gives rise to a ridge called raphe.
- Ovule generally consists of central body of tissue called as nucellus which has abundant reserve food materials.
- Nucellus is surrounded by one or more integuments. A small opening left at the apex of the integuments is called as Micropyle.
- Posterior end of the ovule where nucellus, integuments and funicle fuse together is called chalaza. A large oval structure lies inside the nucellus called as Embryo sac or female gametophyte.

- Bitegmic Ovule**: Nucellus is surrounded by two integuments. Ex: Monocots

### Stages of Megasporogenesis

In the hypodermal region of nucellus towards the micropylar end, develops an archesporial cell. Archesporial cell divides spericlinally to form outer parietal cell and inner sporogenous cell. Sporogenous cell functions as Megaspore mother cell (MMC). MMC undergoes meiosis to form a linear tetrad of four haploid megaspores. Only chalazal megaspore usually remains functional and other three degenerate.



Synergids have special cellular finger like thickenings at the micropylar tip called filiform apparatus.

Filiform apparatus play an important role in guiding the pollen tubes into the synergids. Synergids help pollen tube grow towards egg apparatus by secreting chemotropically active substances. Central cell consists of two polar nuclei. Central cell is diploid.

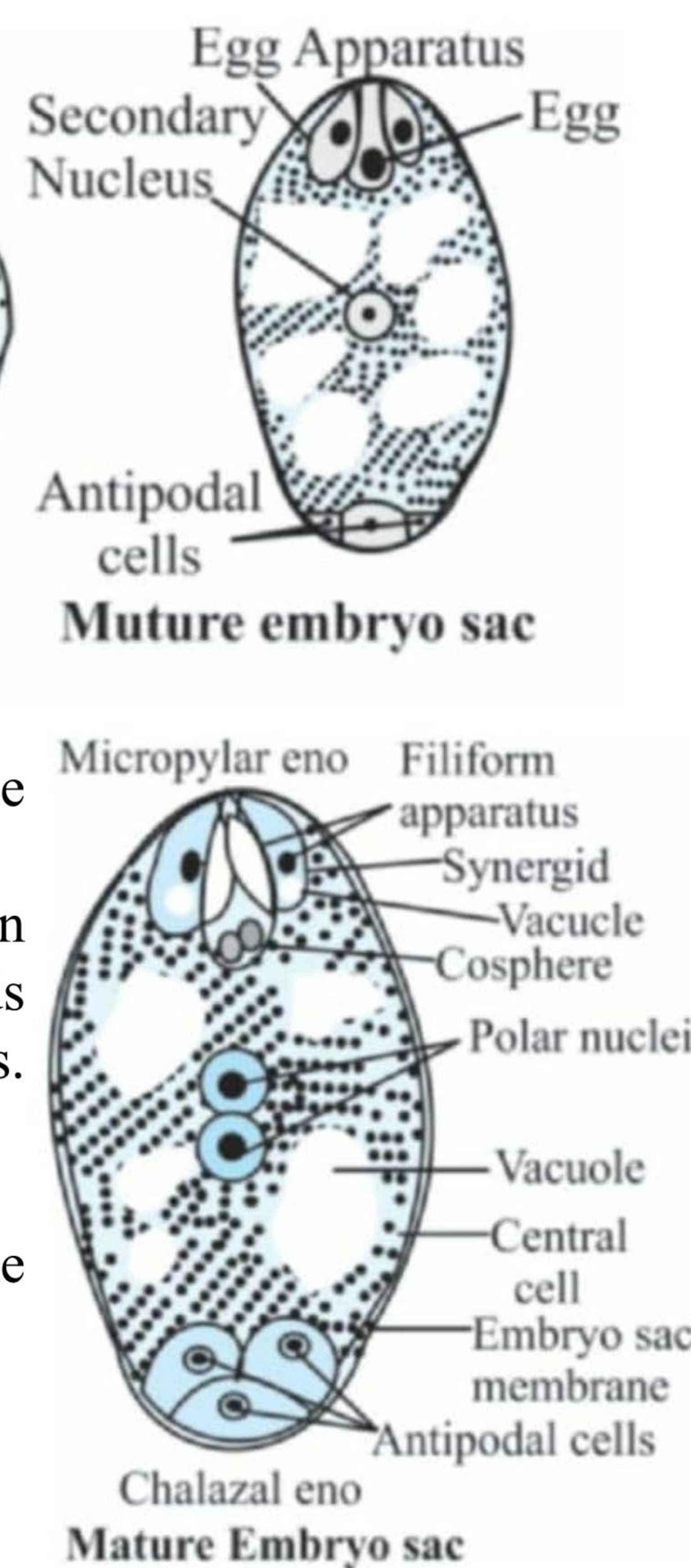
### Types of Embryo sac

- (i) **Monosporic embryo sac**: Embryo sac developed from one megaspore. They are of 2 types

- (a) Polygonum type: It is eight nucleated and seven celled

The functional megaspore develops into female gametophyte.

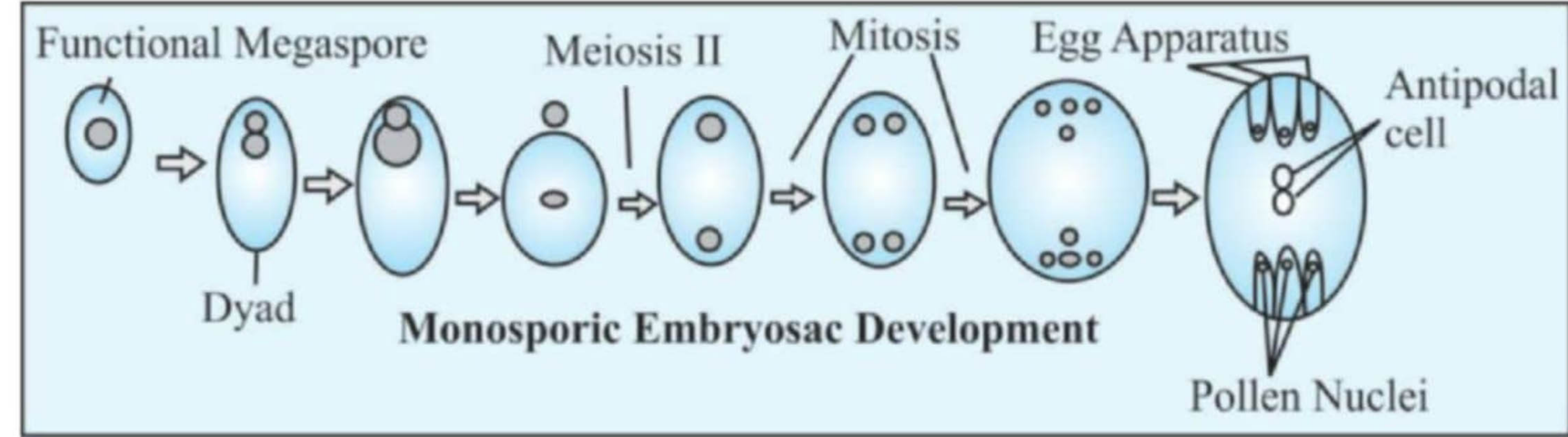
Megaspore is the initial cell of female gametophyte or embryo sac. The nucleus of functional megaspore divides mitotically to form two nuclei which move to the opposite poles. Two more sequential mitotic nuclear division result in the formation of the four nucleate and later eight nucleate stages. Interestingly mitotic division are free nuclear and are not followed by cytokinesis. Cytokinesis takes place at 8-nucleate stage, leading in cell wall formation. Six of the eight nuclei are surrounded by cell walls and organised into cells, remaining 2 nuclei are placed in the centre. Three cells are grouped together at micropylar end and constitute the egg apparatus. Egg apparatus consists of 2 synergids and one egg cell. Three cells are grouped together at chalazal end and are called antipodals. The large central cell has two polar nuclei. Hence the typical angiospermic embryo sac is a 8 nucleate 7 celled.





embryo sac (develops from chalazal end)

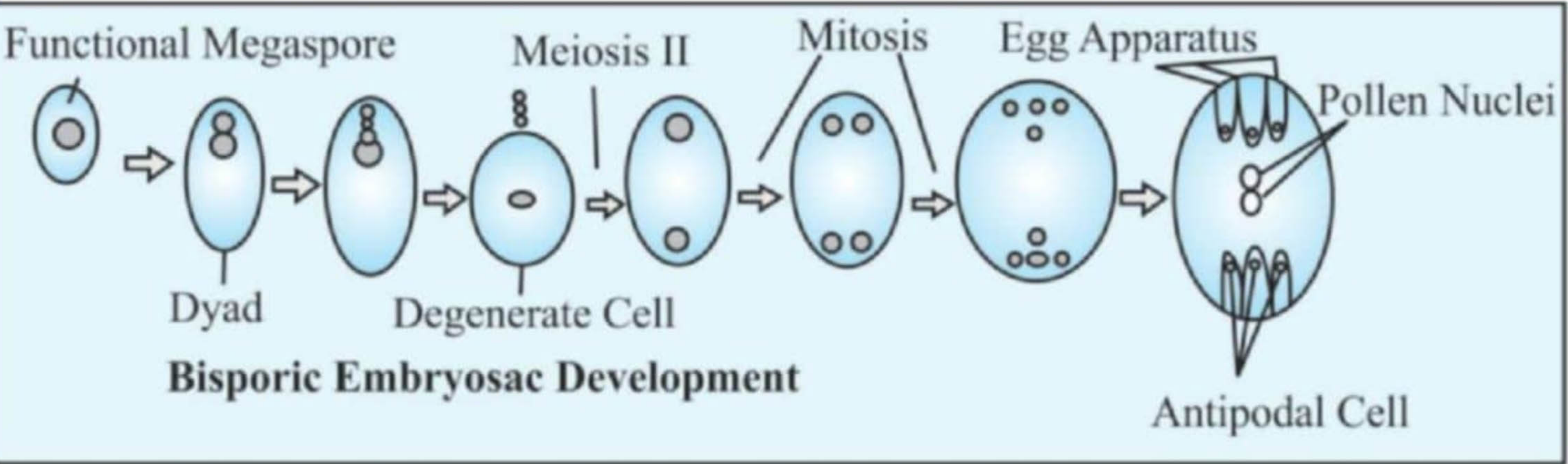
(b) *Oenothera* type : It is 4 nucleated where antipodal cells are absent. One nucleus is present in central cell, three nucleus in the egg apparatus. Embryo sac develops from micropylar megaspore.



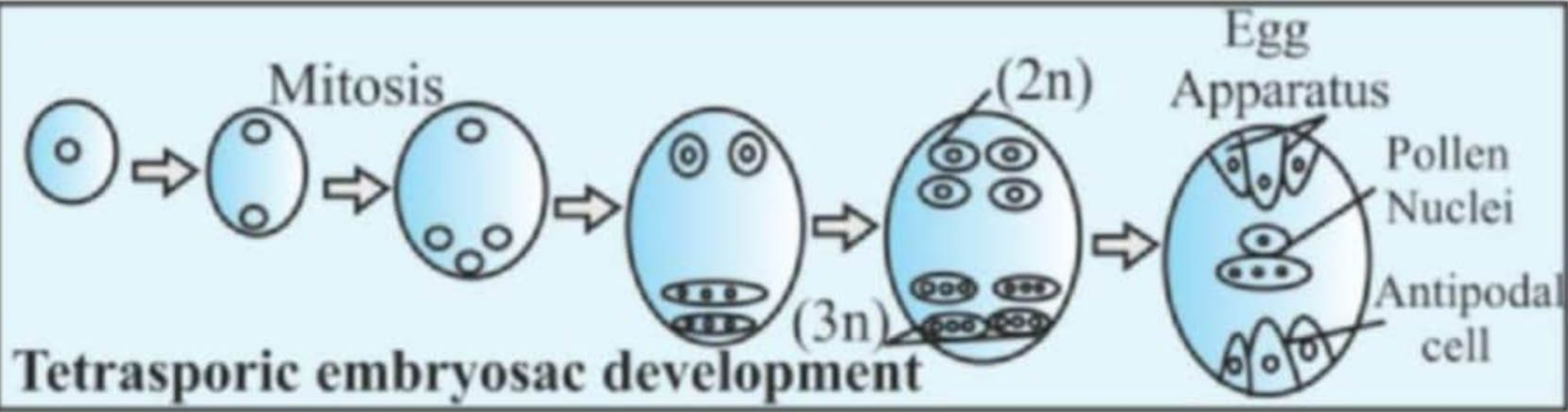
(ii) **Bisporic embryo sac** : It is formed by two megaspores.

(a) *Allium* type : Eight nucleated and seven celled embryosac (develops from chalazal megaspore)

(b) *Endymion* type: Eight nucleated and seven celled embryosac (develops from micropylar megaspore)



(iii) **Tetrasporic Embryo sac** : It is formed by all four megaspore nuclei because meiosis is not accompanied by cytokinesis, so that four nuclei of megaspore are formed.



**Pollination**

The transfer of pollen grains from anther to the stigma is called pollination. Process of pollination occurs before fertilization.

**Self Pollination**

It is the transfer of the pollen grain from anther of the flower to stigma of the same flower or genetically similar flower

**Homogamy**: Condition in which male and female reproductive parts of a bisexual flower mature at the same time.

**Bisexuality** : It corresponds to occurrence of both male and female sex organs in a flower. Eg: Hibiscus

**AGENTS OF POLLINATION**

<p><b>Anemophily</b> Pollination taking place by means of wind. Ex: Grasses, Maize, Sugarcane Characteristic features of wind pollinated flowers:</p> <ul style="list-style-type: none"><li>• Pollen grains are light, small sized, non-sticky and powdery.</li><li>• Stigma is large &amp; feathery to trap pollen grains</li><li>• They have single ovule in each ovary and numerous flowers packed into an inflorescence.</li><li>• Flowers are devoid of scent</li></ul>	<p>Tassel Male inflorescence Female Inflorescence Styles (elongated and silky)</p>	Abiotic agents
<p><b>Hydrophily</b> Pollination taking through water Ex: Some of the hydrophytes Characteristic feature of water pollinated flowers:</p> <ul style="list-style-type: none"><li>• Pollen grains are long and ribbon like</li><li>• Pollen grains are protected from wetting by mucilaginous covering.</li></ul> <p><b>Types of Hydrophily</b></p> <ul style="list-style-type: none"><li>• Hypohydrophily- It occurs below the surface of water. Ex: <i>Zostera</i></li><li>• Epiphydrophily- It occurs above the surface of water. Ex: <i>Vallisneria</i></li></ul>	<p>Male Flowers Pistillate Flowers Water Level Staminate Flowers</p>	
<p><b>Entomophily</b> Pollination which takes place through insects. Ex: <i>Clematis</i> Characteristic feature of insect pollinated flowers:</p> <ul style="list-style-type: none"><li>• Large, Colourful, Showy, fragrant, rich in nectar</li><li>• Provide reward in the form of nectar and pollen</li><li>• Safe place to lay eggs</li><li>• Some flowers produce foul odour to attract flies and beetles</li><li>• Pollen grains are sticky</li></ul>	<p>Bee Flower</p>	Biotic agents
<p><b>Chiropterophily</b> Pollination which takes place through bats. It is common in night blooming plants. Ex: <i>Adansonia</i></p>		
Therophily-Pollination taking place through squirrels, rodents Ex: Proteaceae members		
Ophiophily-Pollination taking place through snakes. Ex: <i>Michelia</i> , <i>Santalum</i>		
Malacophily-Pollination taking place through snails. Ex: <i>Arisaema</i>		

**Cleistogamy**: Condition in which flower never opens thus self pollination takes place, e.g., Commelina



**Autogamy :** Transfer of pollen to stigma takes place in same flower Eg: Rice. Bending of style and filament of 2 organs happens.

**Geitonogamy:** Transfer of pollen grains from stamen to stigma of different flower of same plant

### Cross Pollination

Transfer of pollen grain from anther of the flower to the stigma of different flower of another plant (**Xenogamy**)

**Dichogamy:** condition where male and female sex organs of a flower mature at different times.

**Protandry** - when anthers mature earlier than gynoecium, e.g., *Helianthus*, *Tagetes*.

**Protogyny** - when gynoecium matures earlier than the anther, e.g., *Gloriosa*, *Plantago*

**Self incompatibility:** It refers to failure of pollen to germinate on the stigma of same flower due to physiological or genetic reasons, e.g., tobacco.

**Herkogamy:** It is the presence of natural or physical barriers between androecium and gynoecium of a bisexual flower e.g., in *Calotropis*, pollen grains occur in pollinia which can be lifted by insects only

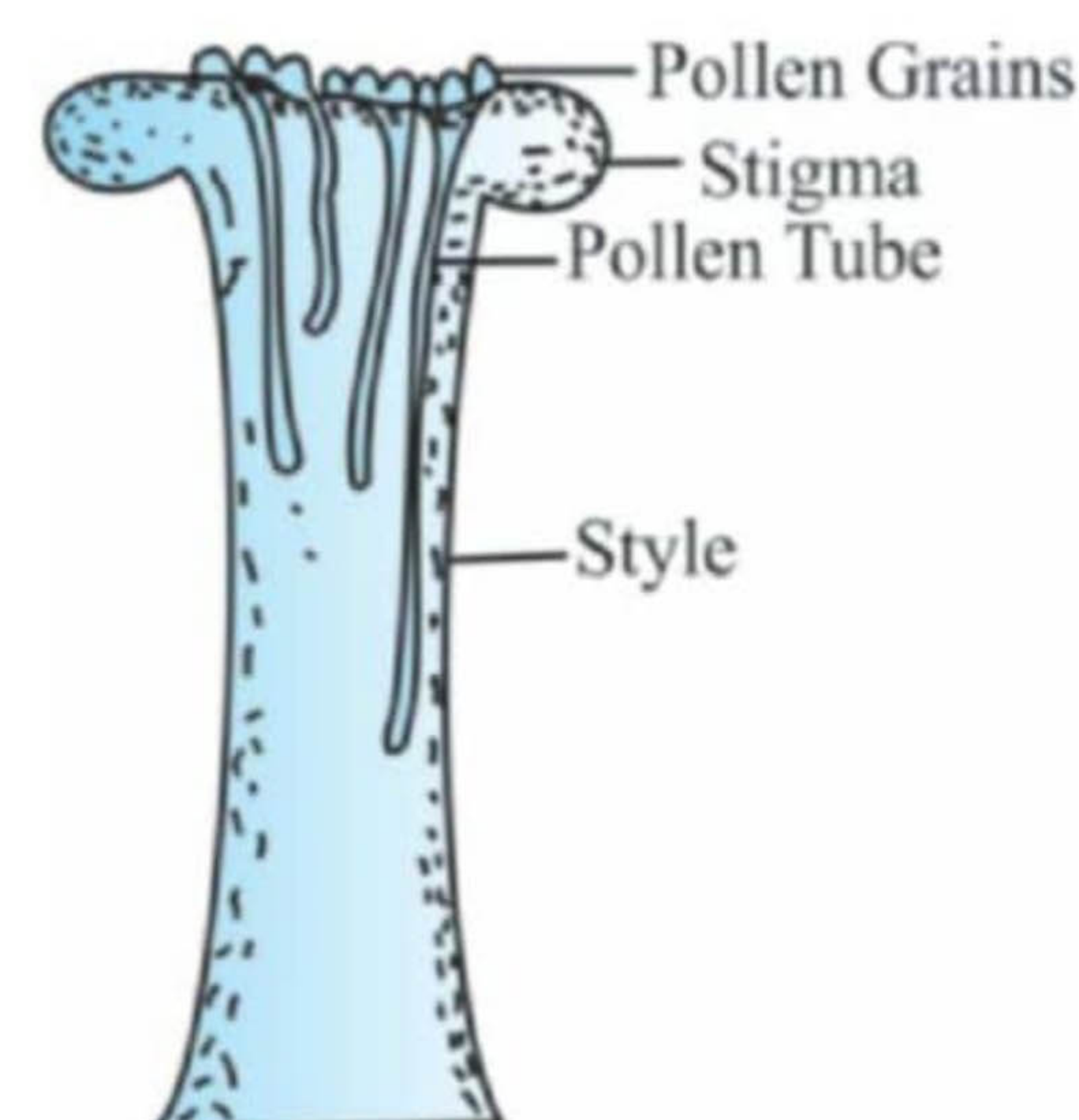
**Heterostyly:** Occurrence of two or more types of flower with regard to length of style and stamens viz. pin eyed (short stamen and long style), thrum eyed (long stamen and short style), e.g., *Primula*

### Pollen – Pistil Interaction

Pollen grains of a number of plants may settle over a stigma. Only the right pollen belonging to same species would germinate while other fail to do so. Compatibility and

Incompatibility is determined by special proteins. Compatible pollen germinate and produce pollen tubes. If the pollen is of wrong type, the pistil rejects the pollen by preventing pollen germination on the stigma or pollen tube growth on the style. The ability of the pistil to recognize the pollen followed by its acceptance or rejection is the result of a continuous dialogue between pollen grain and pistil. This dialogue is mediated by chemical components of the pollen interacting with those of the pistil. All the events from pollen deposition on the stigma to the entry of pollen tube into ovule are together referred as pollen pistil interaction.

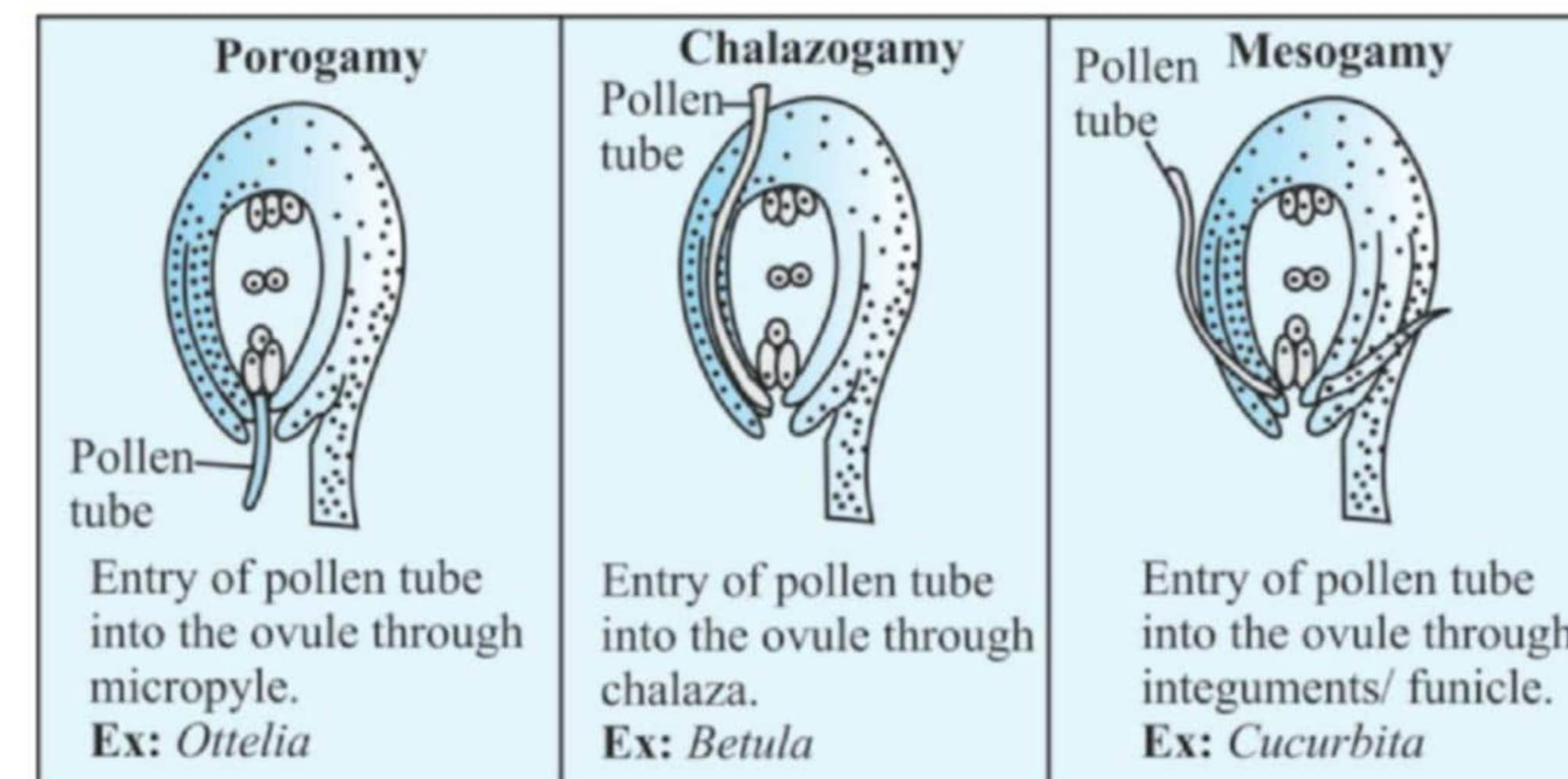
### Pollen germination



Pollen grain after falling on stigma, start germination in the presence of moisture and nutrients available on stigma. Pollen tube emerge from the intine of the pollen grain. It produces enzymes which digest the tissues of the stigma and style. Usually pollen grains are monosiphonous (one pollen tube arise from one pollen grain). Some time it may be Polysiphonous (more than one pollen tube arise from one pollen grain).

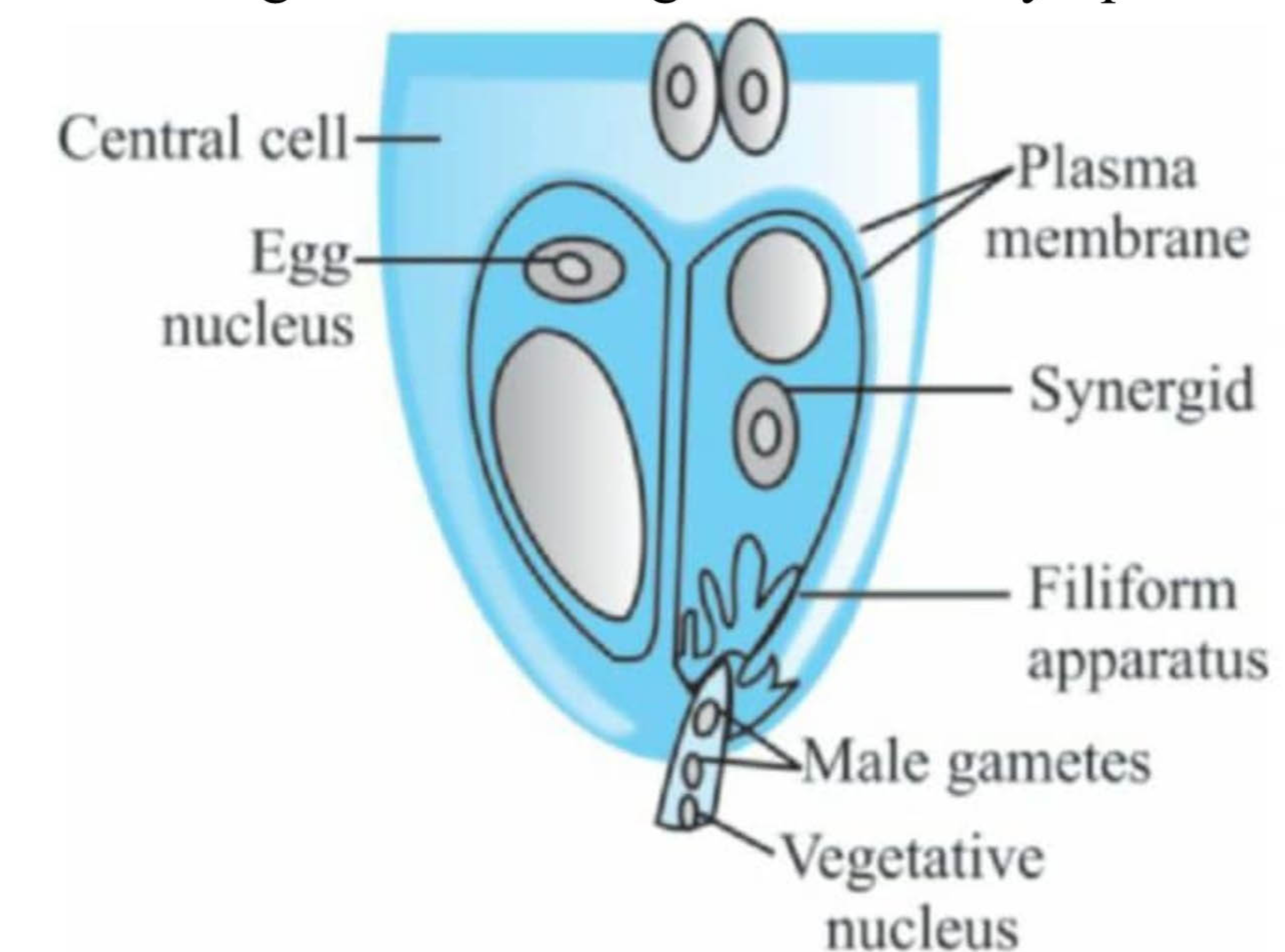
### Entry of Pollen Tube into Ovule

Entry of pollen tube in the ovule is either of the three ways.



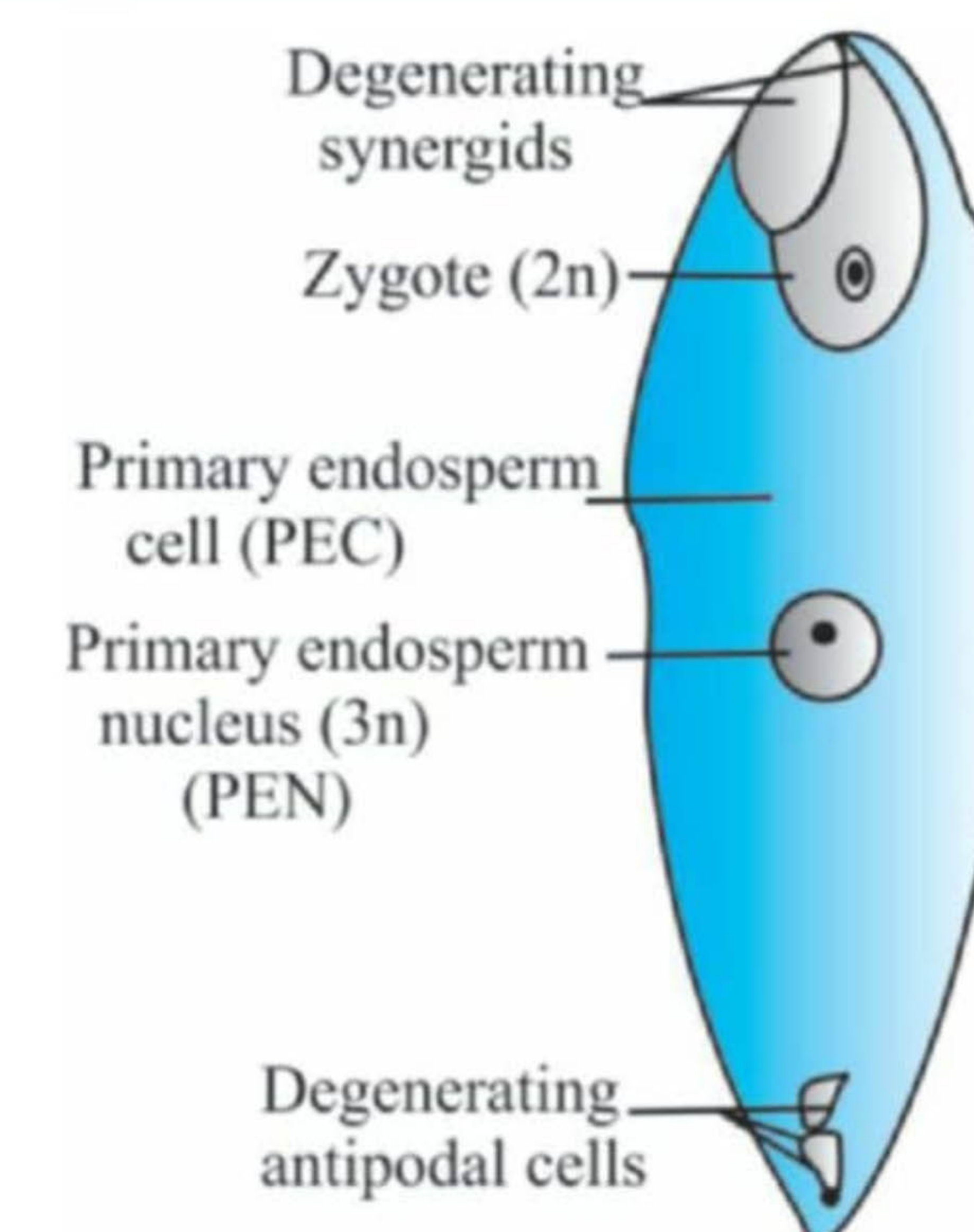
### Fertilization

- Pollen tube enters the tip of the filiform apparatus and enters the cytoplasm of one of the synergids.
- Pollen tube contents gets released into the synergids and tube does not grow beyond it in embryo sac.
- Tip of the pollen tube bursts releasing two male gametes and large amount of cytoplasm.



**Fig: Entry of pollen tube in embryo sac**

- One male gametes fuses with the egg to form zygote (2n). This is called as Syngamy or generative fertilization. It was discovered by Strasburger.
- Second male gamete fuses with two polar nuclei or secondary nucleus of central cell to form triploid primary endosperm nucleus (PEN). This is known as triple fusion. It was discovered by Nawaschin.



- Central cell after triple fusion becomes Primary endosperm cell (PEC).
- Occurrence of syngamy and triple fusion simultaneously in the embryo sac of the angiosperms is called as Double fertilization (discovered by S.G. Nawaschin).
- Zygote develops into embryo and Primary endosperm cell becomes Endosperm.

### MULTIPLE CHOICE QUESTIONS

1. The microspore tetrad of angiosperm at the time of formation, are surrounded by a callose wall. Breakdown of this wall is brought about by the enzyme callase synthesized by the



- (a) Tetrad cytoplasm  
(b) Ribosome of the tetrad  
(c) Spore mother cells  
(d) Cells of tapetum
2. Siphonogamy in angiosperm means  
(a) Tube like male gametes  
(b) Motile male gametes  
(c) Male gametes produced in a tube  
(d) Male gametes are carried in a tube
3. If the diploid number of an angiospermic plant is 24, the number of chromosomes in the pollen grain, endosperm and integument will be  
(a) 12, 36, 24 (b) 12, 24, 36  
(c) 12, 12, 36 (d) 12, 36, 12
4. The endosperm found in angiospermic seed is different from that of gymnosperms in the sense that, in the former  
(a) It is formed before fertilization while in the latter it is formed after fertilization  
(b) It is formed after fertilization while in the latter it is formed before fertilization  
(c) It is cellular while in the latter it is nuclear  
(d) It is nutritive while in the latter it is protective
5. After penetrating stigmatic and styler tissues, the pollen tube usually grow down towards the egg because  
(a) The egg cell attracts the pollen tube as they have dissimilar electric charge  
(b) The filiform apparatus of synergids is believed to attract the pollen tube  
(c) It has no other passage to follow  
(d) It grows under control of nucleus
6. Which of the following statement is correct for the pollen tube  
(a) It shows chemotactic movement  
(b) It shows only tip growth

- (c) It is composed of three non-cellular zones  
(d) It shows radial cytoplasmic streaming
7. A particular species of plant produces light, non sticky pollen in large numbers and its stigma are long and feathery. These modifications facilitate pollination by  
(a) Insects (b) Wind  
(c) Water (d) Animals
8. Which of the following statement is true?  
(i) Pollen release and stigma receptivity are always synchronized in all species.  
(ii) Pollination does not guarantee the transfer of right type of pollen.  
(iii) Micropyle represents the basal part of ovule.  
(iv) Most zygotes divide only after certain amount of endosperm is formed.  
(a) i, iii (b) i, ii, iv  
(c) ii, iv (d) ii, iii, Iv
9. Which of the following nucleus is unlike other nuclei in the female gametophyte of angiosperms?  
(a) Nucleus of antipodals  
(b) Nucleus of synergids  
(c) Secondary nucleus  
(d) None of the above
10. In a flower, if megaspore mother cell forms megaspore without undergoing meiosis and if one on then megaspore develops into an embryo sac, its nuclei would be  
(a) Haploid  
(b) Diploid  
(c) A few haploid and a few diploid  
(d) With varying ploidy
11. What is the correct sequence of the formation of female gametophyte in angiosperms?  
(a) Nucellus, megaspore tetrad, megaspore mother cell, megaspore, female gametophyte

- (b) Megaspore tetrad, nucellus, megaspore mother cell, megaspore, female gametophyte  
(c) Nucellus, megaspore mother cell, megaspore tetrad, megaspore, female gametophyte  
(d) Megaspore mother cell, megaspore tetrad, megaspore, nucellus, female gametophyte

12. Which one of the following statements is correct?  
(a) Cleistogamous flowers are always autogamous.  
(b) Xenogamy occurs only by wind pollination  
(c) Chasmogamous flowers do not open at all  
(d) Geitonogamy involves the pollen and stigma of flowers of different plants
13. Primary endosperm nucleus (PEN) is formed by the fusion of  
(a) 2 polar nuclei + 1 synergid cell nucleus  
(b) 1 polar nucleus + 1 antipodal cell nucleus + 1 synergid cell nucleus  
(c) 2 polar nuclei + 1 male gamete nucleus  
(d) 2 antipodal cell nuclei + 1 male gamete nucleus
14. Which one of the following statements is correct?  
(a) Endothecium produces the microspores  
(b) Tapetum nourishes the developing pollen  
(c) Hard outer layer of pollen is called intine  
(d) Sporogenous tissue is haploid
15. What would be the number of chromosomes in the cells of the aleurone layer in a plant species with 8 chromosomes in its synergids?  
(a) 16 (b) 24 (c) 32 (d) 8

16. Match the following

**Column I**

A. Funicle

**Column II**

(i) Small opening in ovule

- B. Integuments (ii) Stalk of Ovule  
C. Chalaza (iii) Protective envelopes of Ovule  
D. Hilum (iv) Place of junction of body of ovule with stalk  
E. Micropyle (v) Basal part of Ovule  
(a) A- ii, B- iii, C- v, D- iv, E- i  
(b) A- iii, B- ii, C- iv, D- i, E- v  
(c) A- iv, B- iii, C- ii, D- i, E- v  
(d) A- v, B- ii, C- iii, D- i, E- iv
17. Which of the following statements about sporopollenin is false?  
(a) Exine is made up of sporopollenin.  
(b) Sporopollenin is one of the most resistant organic materials.  
(c) Exine has apertures called germ pores where sporopollenin is present.  
(d) Sporopollenin can withstand high temperatures and strong acids.
18. In flowering plants, a mature male gametophyte is derived from a pollen mother cell by  
(a) two mitotic divisions  
(b) one meiotic and two mitotic divisions  
(c) three mitotic divisions  
(d) a single meiotic division
19. Pollen grains are shed at which stage?  
(a) 2 celled  
(b) 3 celled  
(c) Usually at 2-celled, but sometimes at 3-celled  
(d) Single celled
20. A plant has 24 chromosomes in "microspore mother cell". The number of chromosomes in its endosperm will be  
(a) 36 (b) 24 (c) 12 (d) 48



## PREVIOUS YEAR NEET QUESTIONS

21. What type of pollination takes place in *Vallisneria*? (NEET 2019, Odisha)

- (a) Pollination occurs in submerged condition by water
- (b) Flowers emerge above surface of water, and pollination occurs by insects
- (c) Flowers emerge above water surface, and pollen is carried by wind.
- (d) Male flowers are carried by water currents to female flowers at surface of water.

22. Which one of the following statements regarding post-fertilization development in flowering plants is incorrect? (NEET 2019)

- (a) Ovary develops into fruit
- (b) Zygote develops into embryo
- (c) Central cell develops into endosperm
- (d) Ovules develop into embryo sac

23. What is the fate of the male gametes discharged in the synergid? (NEET 2019)

- (a) One fuses with the egg, other(s) degenerate(s) in the synergid.
- (b) All fuse with the egg
- (c) One fuses with the egg, other(s) fuse with synergid nucleus.
- (d) One fuses with the egg and other fuses with central cell nuclei

24. Double fertilization is (NEET 2018)

- (a) Fusion of two male gametes of a pollen tube with two different eggs
- (b) Fusion of one male gamete with two polar nuclei
- (c) Fusion of two male gametes with one egg
- (d) Syngamy and triple fusion

25. A dioecious flowering plant prevents both: (NEET 2017)

- (a) Autogamy and geitonogamy
- (b) Geitonogamy and xenogamy

(c) Cleistogamy and xenogamy

(d) Autogamy and xenogamy

## ANSWER KEY

- |       |       |       |       |       |
|-------|-------|-------|-------|-------|
| 1. d  | 2. d  | 3. a  | 4. b  | 5. b  |
| 6. a  | 7. b  | 8. c  | 9. c  | 10. b |
| 11. c | 12. a | 13. c | 14. b | 15. b |
| 16. a | 17. c | 18. b | 19. c | 20. a |
| 21. d | 22. d | 23. d | 24. d | 25. a |

## HINTS &amp; SOLUTIONS

1. (d) Callose is a layer which is around the tetrads. Enzyme released from tapetum called callase will dissolve the callose and microspores will get separated.
2. (d) In angiosperms, pollen tube will carry 2 male gametes from stigma till embryo sac. This is called as Siphonogamy.
3. (a) Pollen grains, endosperm in angiosperm and integuments are always haploid, triploid and diploid respectively. In a diploid plant with chromosome number 24, pollen grains, endosperm and integuments will have 12, 36, 24 chromosomes respectively.
4. (b) In angiosperm there is triple fusion hence there is formation of triploid endosperm. In Gymnosperm there is no double fertilization, hence the endosperm is diploid.
5. (b) In the embryo sac there is filiform apparatus which will attract pollen tube towards the synergids.
6. (a) Growth of pollen tube is said to be chemotactic movement as in the presence of chemicals like calcium-boron they will grow.
7. (b) Anemophilous flowers have light, non-sticky pollen in large numbers and its stigma are long and feathery.

8. (c) Pollen release and stigma receptivity should be synchronised so that self pollination takes place. But some flowers support cross pollination, in which pollen release and stigma receptivity will not be synchronised. Basal part of ovule is chalaza.

9. (c) Secondary nucleus are the nucleus present in the central cell of embryo sac.

10. (b) If megaspore mother cell undergoes meiosis then the nucleus of the embryo sac will be haploid. But if megaspore mother cell does not undergoes meiosis then the nucleus of the embryo sac will be diploid.

11. (c) Hypodermal region of nucellus develops an archesporial cell. Archesporial cell divides periclinally to form outer parietal cell and inner sporogenous cell. Sporogenous cell functions as Megaspore mother cell (MMC). MMC undergoes meiosis to form a linear tetrad of four haploid megaspores. Among 4 megaspore, three will degenerate and one will remain functional. Functional megaspore will develop into female gametophyte.

12. (a) Cleistogamous flowers are unopened flowers hence there is no chance of cross pollination and they always undergo self pollination.

13. (c) During triple fusion, one male gamete fuses with secondary nucleus and hence form triploid primary endosperm nucleus (PEN).

14. (b) Tapetum is nutritious tissue which provides nourishment for the growing pollen grains.

15. (b) Synergids are haploids and aleurone layer is triploid. If synergids are having 8 chromosomes then aleurone layers will have 24 chromosomes.

16. (a) Funicle is the stalk of the ovule. The point of attachment of the body of ovule with funicle is called Hilum. Basal part of Ovule is chalaza. Ovule is covered by integuments and

small opening in ovule where integuments are not covered is called as micropyle.

17. (c) Exine has apertures called germ pores. Germ pores does not have sporopollenin.

18. (b) Pollen mother cell (PMC) undergoes one meiotic and two mitotic divisions to form mature gametophyte.

19. (c) Pollen grains are usually shed at 2-celled stage but in some plants it sheds at 3-celled stage also.

20. (a) Microspore mother cell is a diploid and endosperm in angiosperm is triploid. If the number of chromosomes in the microspore mother cell is 24, then the chromosomes in endosperm will be 36.

21. (d) *Vallisneria* undergoes epihydrophyly, where male gametes are carried by water currents to female flowers at surface of water.

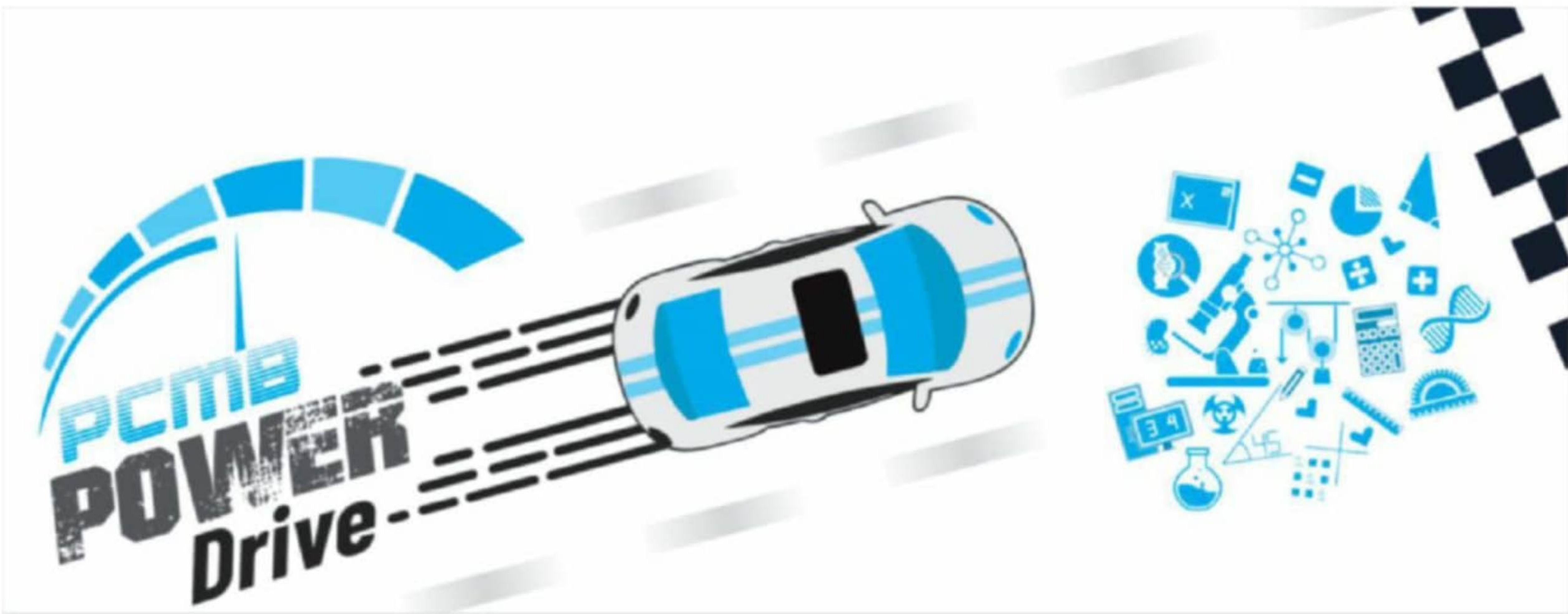
22. (d) Embryo sac is present inside the ovule. Hypodermal region of nucellus develops an archesporial cell. Archesporial cell divides periclinally to form outer parietal cell and inner sporogenous cell. Sporogenous cell functions as Megaspore mother cell (MMC). MMC undergoes meiosis to form a linear tetrad of four haploid megaspores. Among 4 megaspore, three will degenerate and one will remain functional. Functional megaspore will develop into female gametophyte.

23. (d) Pollen tube get burst in the synergid and male gametes are discharged in it. In it one male gamete fuses with the egg and other gamete uses with central cell nuclei.

24. (d) Double fertilization is fusion of male gamete and female gamete (syngamy) as well as fusion of secondary nucleus with male gamete (triple fusion).

25. (a) When the male and female flowers occur on separate plants the condition is called *dioecious* and it prevents both autogamy and geitonogamy





BREATHING AND EXCHANGE OF GASES

By: **Murali Krishna** (Hyderabad)

- Oxygen ( $O_2$ ) is utilised by the organisms to indirectly break down simple molecules like glucose, amino acids, fatty acids, etc., to derive energy to perform various activities. So,  $O_2$  has to be continuously provided to the cells.
- Carbon dioxide ( $CO_2$ ) which is also released during the above catabolic reactions is harmful. So,  $CO_2$  produced by the cells has to be sent out of the body.

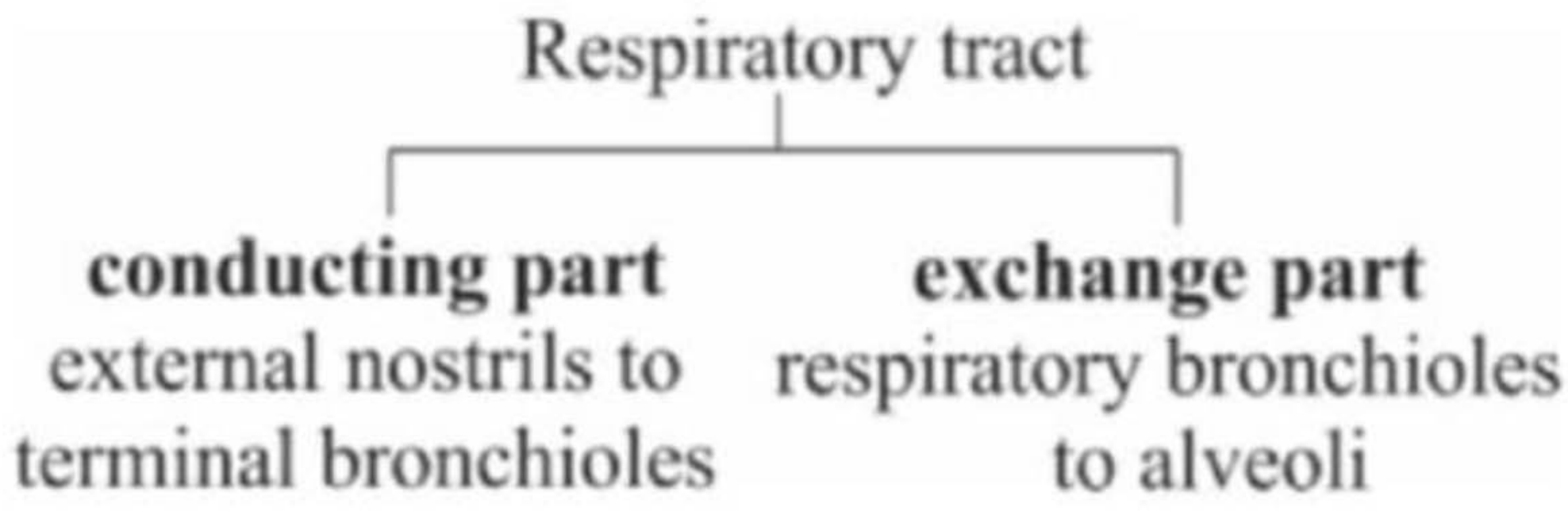
Respiratory Organs

- Mechanisms of breathing vary among different groups of animals depending mainly on their habitats and levels of organisation.

Sponges, coelenterates, flatworms	Entire body surface
Earthworms	Moist cuticle
Insects	Tracheal tubes
Most aquatic arthropods and molluscs	Gills (branchial respiration)
Land snails	Lungs (pulmonary sacs)
Fishes	Gills
Amphibians	Larvae: Gills (branchial) Adult: Skin (cutaneous), lungs (pulmonary), buccal cavity (buccal)
Reptiles, birds and mammals	Lungs (pulmonary respiration)

Human Respiratory System

- External nostrils  $\rightarrow$  nasal chamber  $\rightarrow$  pharynx  $\rightarrow$  larynx  $\rightarrow$  trachea.
- A portion of pharynx is the common passage for food and air.
- Larynx is a cartilaginous box which helps in sound production (sound box).
- During swallowing glottis can be covered by a thin elastic cartilaginous flap called epiglottis to prevent the entry of food into the larynx.
- Trachea divides at the level of 5th thoracic vertebra into a right and left primary bronchi.
- Trachea  $\rightarrow$  primary bronchi  $\rightarrow$  secondary bronchi  $\rightarrow$  tertiary bronchi  $\rightarrow$  primary bronchioles  $\rightarrow$  secondary bronchioles  $\rightarrow$  tertiary bronchioles  $\rightarrow$  terminal bronchioles  $\rightarrow$  alveolar ducts  $\rightarrow$  alveoli.
- The tracheae, primary, secondary and tertiary bronchi, and initial bronchioles are supported by incomplete cartilaginous rings made up of hyaline cartilage.
- The branching network of bronchi, bronchioles and alveoli comprise the lungs.
- Lungs are covered by a double layered pleura.
- The outer parietal pleural membrane is in close contact with the thoracic lining whereas the inner visceral pleural membrane is in contact with the lung surface.
- Pleural fluid between the two pleural membranes reduces friction on the lung-surface. It also causes the two membranes to adhere to each other.



- *Functions of the conducting part:*
  - ❖ Transports the atmospheric air to the alveoli
  - ❖ Clears the air from foreign particles
  - ❖ Humidifies the air
  - ❖ Brings the air to body temperature.
- Exchange part is the site of actual diffusion of  $O_2$  and  $CO_2$  between blood and atmospheric air.
- The lungs are situated in the thoracic chamber which is anatomically an air-tight chamber.
- The thoracic chamber is formed dorsally by the vertebral column, ventrally by the sternum, laterally by the ribs and on the lower side by the dome-shaped diaphragm.
- The anatomical setup of lungs in thorax is such that any change in the volume of the thoracic cavity will be reflected in the lung (pulmonary) cavity.
- We cannot directly alter the pulmonary volume.

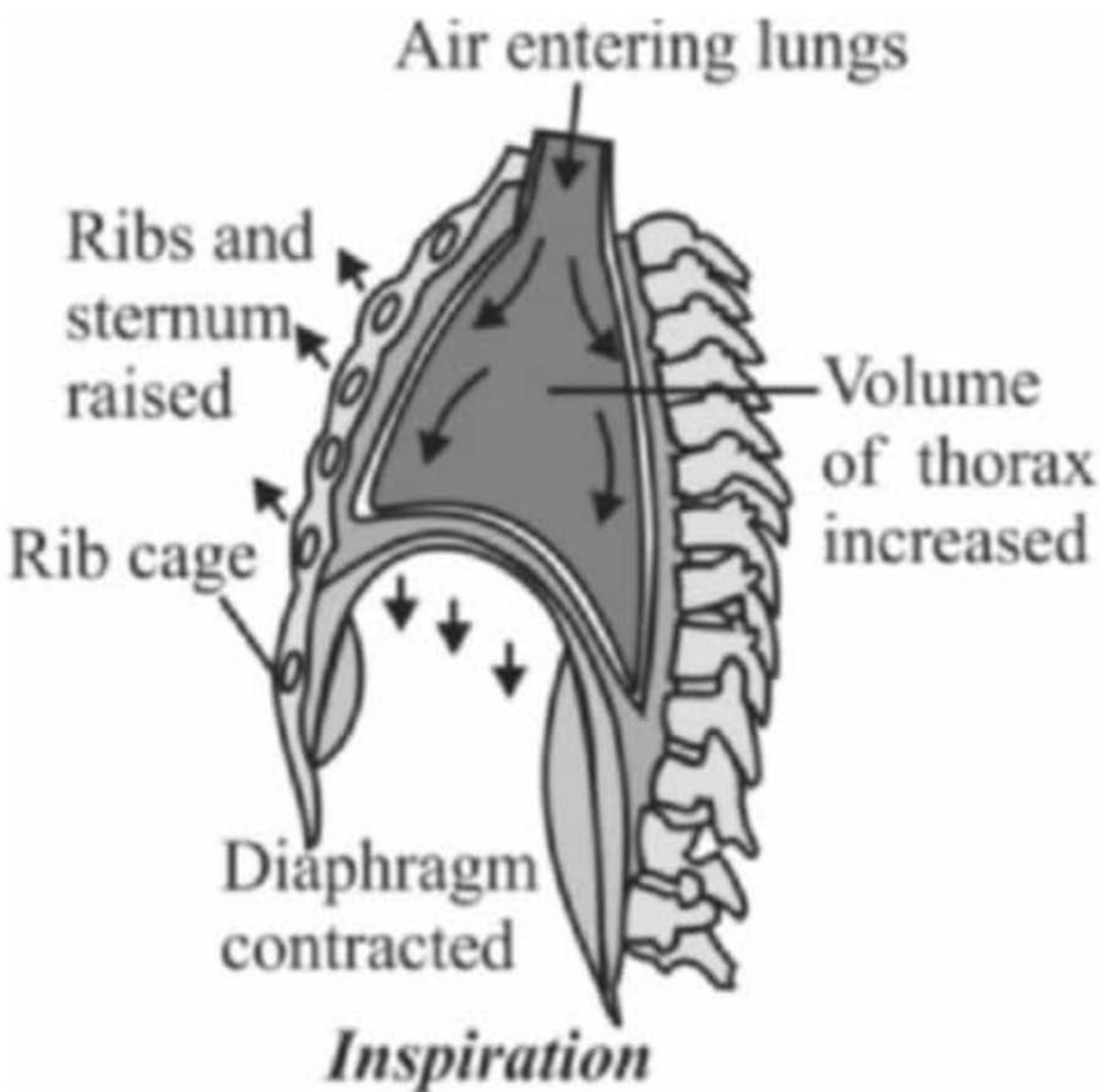
Breathing (pulmonary ventilation)	Atmospheric air is drawn in and $CO_2$ - rich alveolar air is released out.
External respiration (pulmonary gas exchange)	Diffusion of $O_2$ and $CO_2$ across alveolar membrane.
Transport of gases	Transport of gases by the blood.
Internal respiration (systemic gas exchange)	Diffusion of $O_2$ and $CO_2$ between blood and tissues
Cellular respiration	Utilisation of $O_2$ by the cells for Catabolic reactions and resultant release of $CO_2$

Mechanism of Breathing

- The movement of air into and out of the lungs is carried out by creating a pressure gradient between the lungs and the atmosphere.
- Inspiration can occur if the pressure within the lungs (intra-pulmonary pressure) is less than the atmospheric pressure, i.e., there is a *negative pressure* in the lungs with respect to atmospheric pressure.
- Expiration takes place when the intra-pulmonary pressure is higher than the atmospheric pressure.
- The diaphragm and intercostal muscles help in generation of pressure gradients.
- External and internal intercostal muscle extend between the ribs.

Inspiration

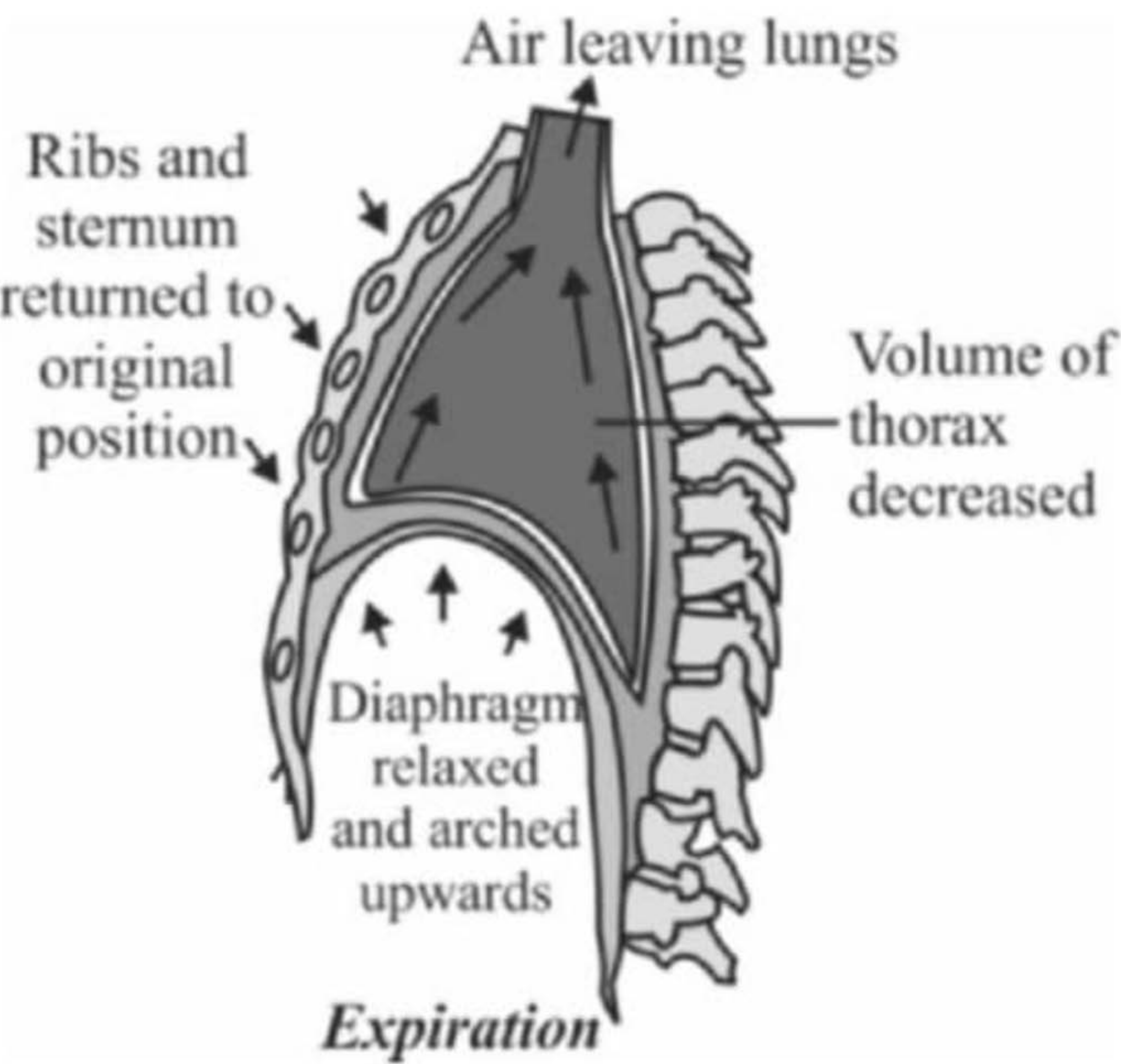
- Inspiration is initiated by the contraction of diaphragm which increases the volume of thoracic chamber in the antero-posterior axis (vertical axis).
- The contraction of external inter-costal muscles lifts up the ribs and the sternum causing an increase in the volume of the thoracic chamber in the dorso-ventral axis.
- $\uparrow$  in the thoracic volume  $\rightarrow \uparrow$  in pulmonary volume  $\rightarrow \downarrow$  in intra-pulmonary pressure (to  $<$  atm. pressure)  $\rightarrow$  inspiration.





Expiration

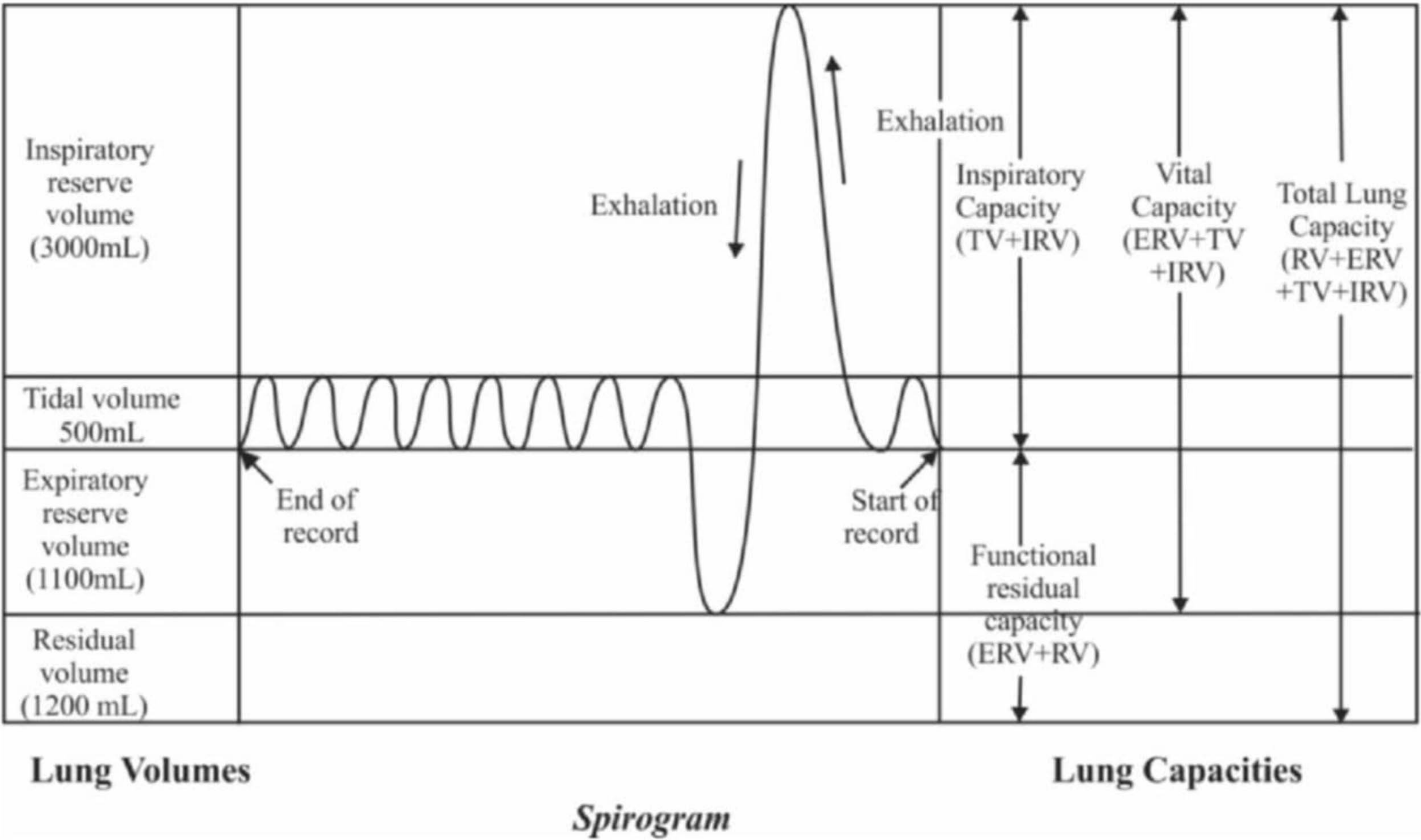
- Relaxation of the diaphragm and the external inter-costal muscles returns the diaphragm and sternum to their normal positions and reduce the thoracic volume and thereby the pulmonary volume (normal expiration).
- ↓ in thoracic volume → ↓ in pulmonary volume → ↑ in intra-pulmonary pressure (to > atm. Pressure) → expiration.



- We have the ability to increase the strength of inspiration and expiration with the help of additional muscles in the abdomen.
- Normal expiration is a passive process (occurs by relaxation of diaphragm and external intercostal muscles) whereas **forced expiration** is an active process (involves contraction of internal intercostal and abdominal muscles).
- On an average, a healthy human breathes 12-16 times/minute.

Lung Volumes and Capacities

- The volume of air involved in breathing movements can be estimated by using a **spirometer** which helps in clinical assessment of pulmonary functions.
- By adding up a few respiratory volumes, one can derive various pulmonary capacities, which can be used in clinical diagnosis.
- Residual volume cannot be measured using normal spirometry (NEET 2017 regional language paper).



Lung Volumes

Lung Capacities

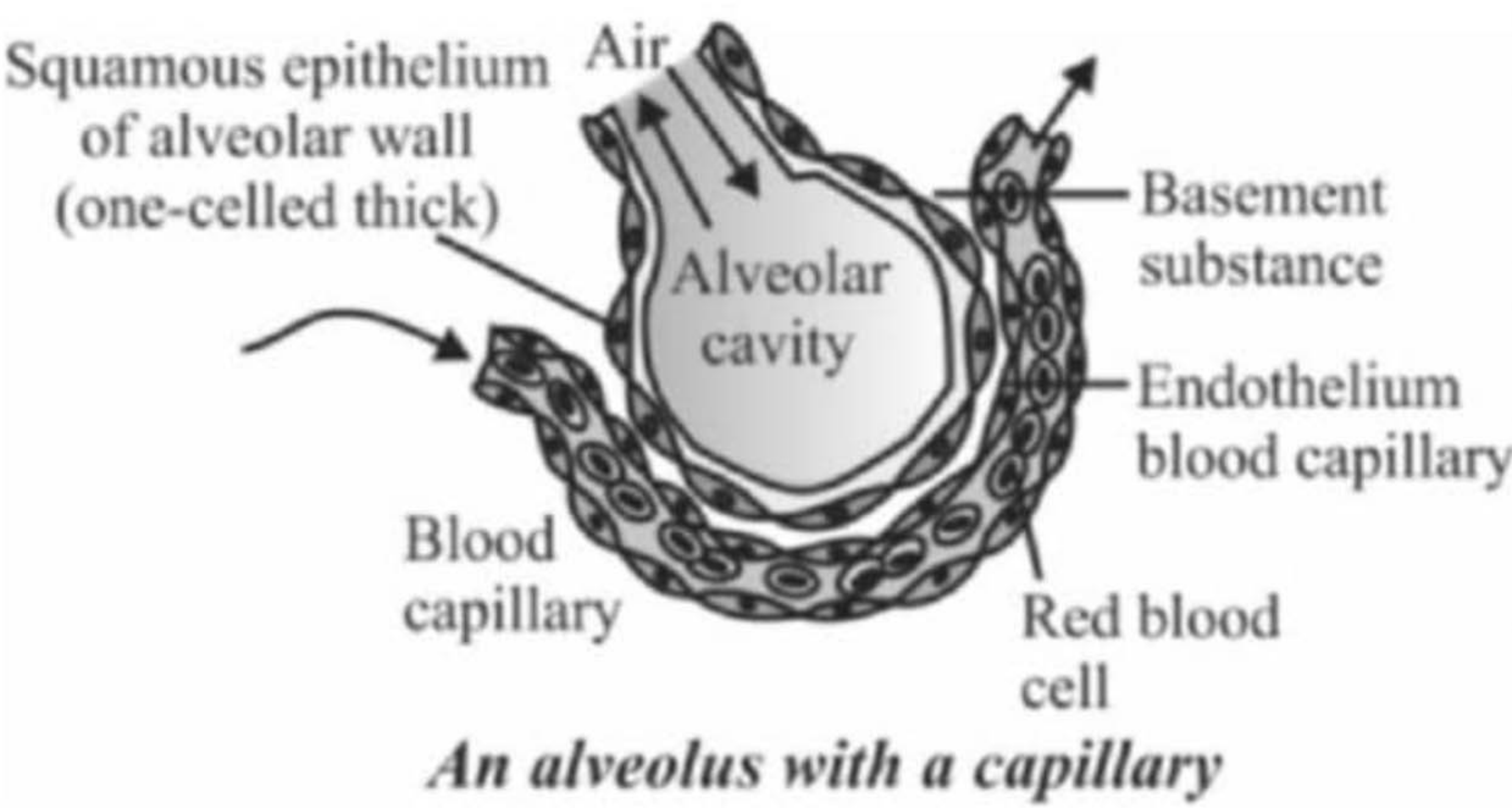
Tidal volume (TV)	Volume of air inspired or expired during a normal respiration	500 mL (6,000 to 8,000 mL min <sup>-1</sup> )
Inspiratory Reserve volume (IRV)	Additional volume of air, a person can inspired by a forcible inspiration.	2,500-3,000 mL
Expiratory Reserve Volume (ERV)	Additional volume of air, a person can expired by a forcible expiration.	1,000-1,100 mL
Residual volume (RV)	Volume of air remaining in the lungs even after a forcible expiration.	1,100-1,200 mL
Inspiratory capacity (IC)	Total (maximum) volume of air a person can inspire after a normal expiration	TV+IRV
Expiratory capacity (EC)	Total (maximum) volume of air a person can expire after normal inspiration	TV+ERV
Functional Residual capacity (FRC)	Volume of air that will remain in the lungs after a normal expiration	ERV+RV
Vital capacity (VC)	The maximum volume of air a person can breath in after a forced expiration (or breath out after a forced inspiration)	IRV+TV+ERV
Total Lung Capacity (TLC)	Total volume of air accommodated in the lungs at the end of a forced inspiration	IRV+TV+ERV+RV (VC+RV)

Exchange of Gases

	Atmosphere	Alveoli	Deoxygenated blood	Oxygenated blood	Tissues
pO <sub>2</sub> (mm HG)	159	104	40	95	40
pCO <sub>2</sub> (mm HG)	0.3	40	45	40	45

- Alveoli are the primary sites of exchange of gases (pulmonary gas exchange).
- Exchange of gases also occurs between blood and tissues (systemic gas exchange).
- O<sub>2</sub> and CO<sub>2</sub> are exchanged in these sites by simple diffusion.
- *Factors affecting the rate of diffusion:*
  - ❖ Pressure/concentration gradient (primary factor)
  - ❖ Solubility of the gases
  - ❖ Thickness of the membranes
- There is a concentration gradient for oxygen favours its diffusion from alveoli to blood and blood to tissues.
- Concentration gradient for CO<sub>2</sub> favours its diffusion from tissues to blood and blood to alveoli.
- As the solubility of CO<sub>2</sub> is 20-25 times higher than that of O<sub>2</sub>, the amount of CO<sub>2</sub> that can diffuse through the diffusion membrane per unit difference in partial pressure is much higher compared to that of O<sub>2</sub>.
- *Layers in the diffusion (respiratory) membrane:*
  - ❖ Squamous epithelium of alveoli
  - ❖ Basement substance
  - ❖ Endothelium of alveolar capillaries



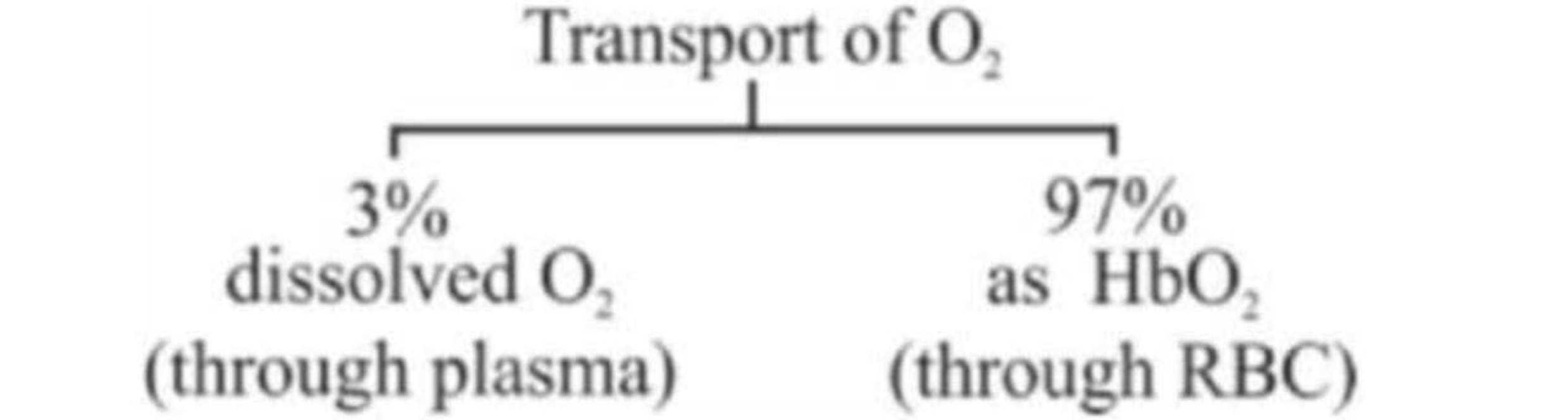


- The total thickness of basement substance is much less than a millimetre.

Transport Of Gases

- Blood is the medium of transport for O<sub>2</sub> and CO<sub>2</sub>.

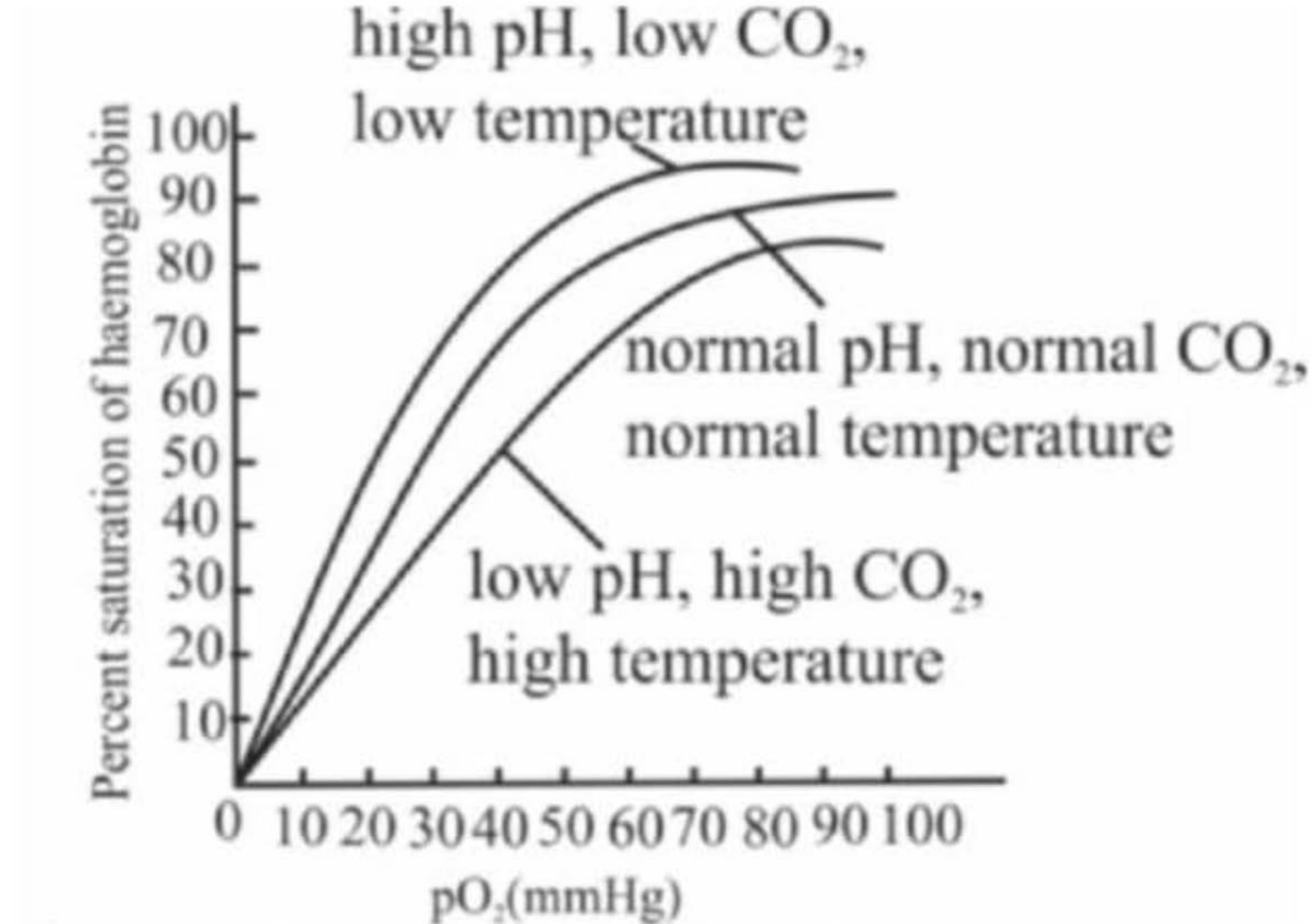
Transport of Oxygen



- Haemoglobin is a red coloured iron containing pigment present in the RBCs.
- It includes four haeme groups and four polypeptides (two alpha and two beta).
- One O<sub>2</sub> can bind to Fe<sup>2+</sup> (ferrous ion) at the centre of each of the four haeme groups.
- Thus, each haemoglobin molecule can carry a maximum of four molecules of O<sub>2</sub>.
- Binding of oxygen with haemoglobin is primarily related to pO<sub>2</sub>.
- A sigmoid **oxygen dissociation curve** is obtained when percentage saturation of haemoglobin with O<sub>2</sub> is plotted against the pO<sub>2</sub>.

Conditions in the alveoli that favour the formation of HbO <sub>2</sub>	Conditions in the tissues that favour the disassociation of HbO <sub>2</sub>
↑ pO <sub>2</sub>	↓ pO <sub>2</sub>
↓ pCO <sub>2</sub>	↑ pCO <sub>2</sub>
↓ H <sup>+</sup> (↑ pH)	↑ H <sup>+</sup> (↓ pH)
↓ temperature	↑ temperature
↓ 2,3 BPG	↑ 2,3 BPG

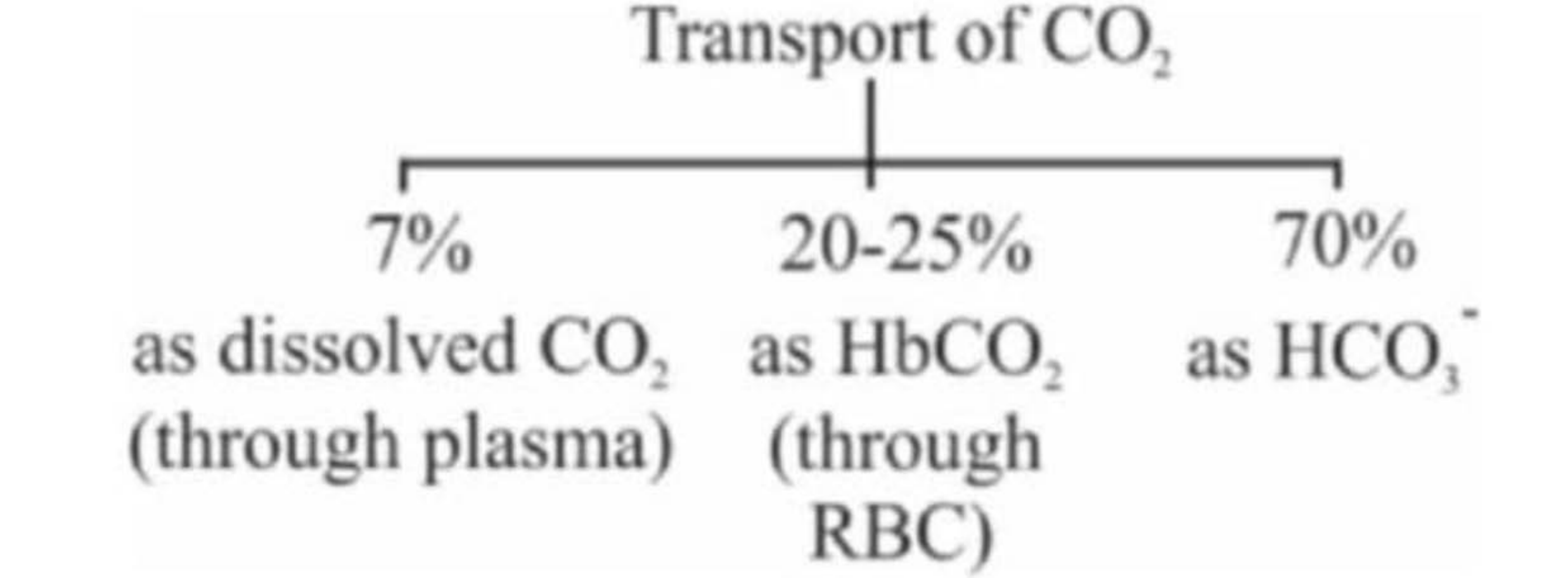
- Oxygen dissociation curve is highly useful in studying the effect of factors like pCO<sub>2</sub>, H<sup>+</sup> concentration, temperature, etc., on binding of O<sub>2</sub> with haemoglobin.
- Effect of CO<sub>2</sub> and H<sup>+</sup> on the oxygen-affinity of haemoglobin is termed **Bohr effect** (shifts the curve toward right).



Oxygen-haemoglobin dissociation curve and Bohr effect

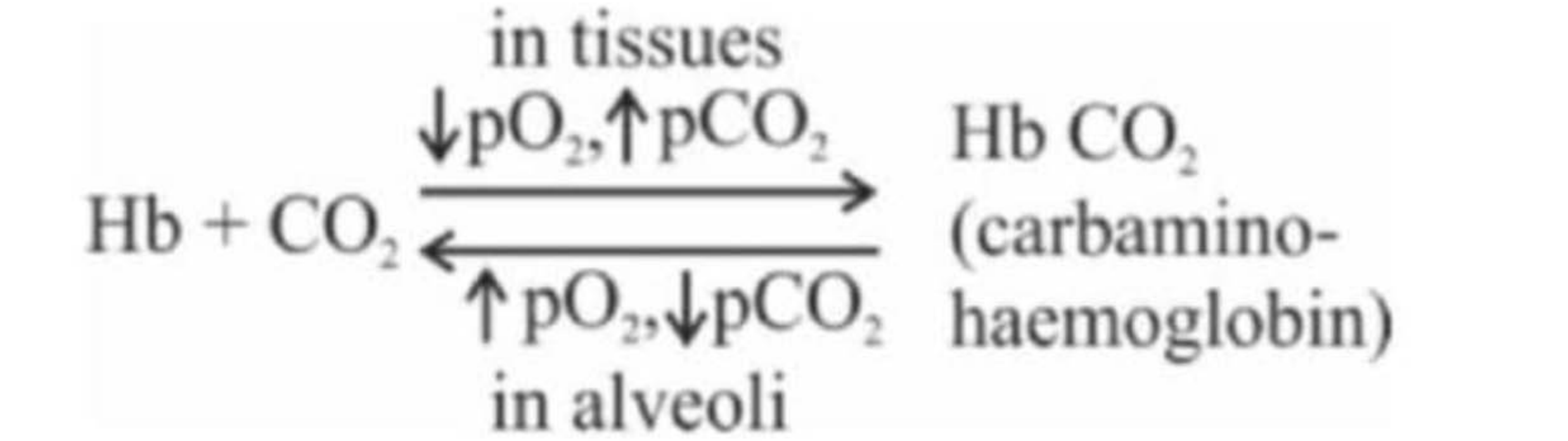
- Every 100 ml of oxygenated blood can deliver around 5 ml of O<sub>2</sub> to the tissues under normal physiological conditions.

Transport of Carbon dioxide



As HbCO<sub>2</sub>

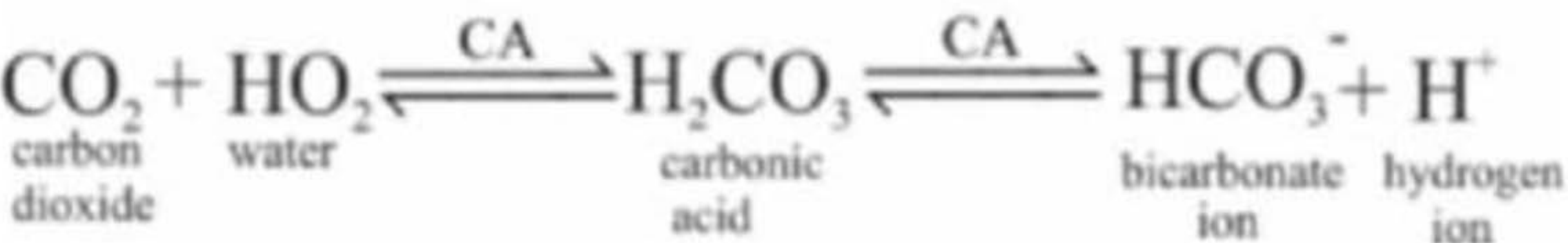
- The binding of CO<sub>2</sub> to Hb is related to the partial pressure of CO<sub>2</sub>.
- pO<sub>2</sub> is a major factor which could affect this binding.



As Bicarbonates

- RBCs contain a very high concentration of the enzyme carbonic anhydrase.
- A minute quantities carbonic anhydrase is present in the plasma too.

- Carbonic anhydrase facilitates the following reaction in both directions.



At tissues:

- As pCO<sub>2</sub> is high, CO<sub>2</sub> forms HCO<sub>3</sub><sup>-</sup> and H<sup>+</sup>.
- Some HCO<sub>3</sub><sup>-</sup> diffuses into plasma in exchange for Cl<sup>-</sup> (plasma membrane of RBC is impermeable to cations). This termed **chloride shift**, or Hamburger's phenomenon.

At alveoli:

- As pCO<sub>2</sub> is low, the reaction proceeds in the opposite direction leading to the formation of CO<sub>2</sub> and H<sub>2</sub>O.
- HCO<sub>3</sub><sup>-</sup> diffuses back into RBC and Cl<sup>-</sup> diffuse back into plasma (reverse chloride shift).
- Thus, CO<sub>2</sub> trapped as bicarbonate at the tissue level and transported to the alveoli is released out as CO<sub>2</sub>.
- Every 100 ml of deoxygenated blood delivers approximately 4 ml of CO<sub>2</sub> to the alveoli.

Regulation Of Respiration

- Human beings have a significant ability to maintain and moderate the respiratory rhythm to suit the demands of the body tissues. This is done by the neural system.
- Respiratory rhythm centre in the medulla is primarily responsible for the regulation of ventilation.
- Pneumotaxic centre can moderate the functions of the respiratory rhythm centre.

Center	Location	Function
Respiratory rhythm center	Medulla oblongata	Responsible for basic rhythm
Pneumotaxic center	Pons	Reduces duration of inhalation
Apneustic center	Pons	Increases duration of inhalation

- A **chemosensitive area** is situated adjacent to the rhythm centre which is highly sensitive to CO<sub>2</sub> and H<sup>+</sup>.

- Increase in CO<sub>2</sub> and H<sup>+</sup> can activate this centre, which in turn can signal the rhythm centre to make necessary adjustments in the respiratory process by which these substances can be eliminated.

- Receptors associated with **aortic arch** and **carotid artery** also can recognise changes in CO<sub>2</sub> and H<sup>+</sup> concentration and send necessary signals to the rhythm centre for remedial actions.

- The role of oxygen in the regulation of respiratory rhythm is quite insignificant.

- When you hold your breath, rising CO<sub>2</sub> level in the arterial blood would first lead to the urge to breathe (AIPMT 2015C).

Disorders Of Respiratory System

Asthma

- It is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles.

Emphysema

- It is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased.
- One of the major causes of emphysema is cigarette smoking.
- Alpha-1-antitrypsin can be used in the treatment.

Occupational Respiratory Disorders:

- In certain industries, especially those involving grinding or stone-breaking, so much dust is produced that the defense mechanism of the body cannot fully cope with the situation.
- Long exposure to dust can give rise to inflammation leading to fibrosis and thus, serious lung damage.
- Workers in such industries should wear protective masks.

Asbestosis	Asbestos dust
Silicosis	Silica dust
Siderosis	Iron particles
Black-lung disease/anthracosis	Coal dust



Some Other Important Points Beyond Ncert Textbook:

- In birds, air sacs are connected to the lungs. The passage of air through the parabronchi is continuous and unidirectional. Hence always fresh air passes through parabronchi.
- Three thin twisted bony plates called nasal *conchae*, or turbinals curl out from the lateral walls of each nasal cavity.
- Thyroid is the largest cartilage of the larynx.
- The anterior prominence of the thyroid cartilage is called *Adam's apple* (larger in males).
- The space between the true vocal cords (vocal folds) is called the *rima glottidis*.
- The right lung as two lobes while the left lung has three lobes.
- Type II alveolar cells secrete alveolar fluid containing *surfactant*.
- Surfactant lowers the surface tension of alveolar fluid, which reduces the tendency of alveoli to collapse.
- *Intrapleural pressure* is always less than alveolar pressure. This prevents complete collapse of alveoli during expiration (NEET-II 2016).
- Residual volume cannot be measured using normal spirometry (NEET 2017 R.L.).
- The capacity of 1gram of haemoglobin to combine with oxygen is 1.34 ml.
- About 97% of haemoglobin is saturated at a  $pO_2$  of 95 mmHg (in systemic arteries).
- About 75% of haemoglobin is saturated at a  $pO_2$  of 40 mmHg (in resting tissues).
- A large proportion of oxygen remains unused in the human blood even after its uptake by the body tissues. This  $O_2$  acts as a reserve during muscular exercise (AIPMT 2011).
- The **P50** is the oxygen tension at which haemoglobin is 50% saturated. The normal P50 of haemoglobin is 26.7 mm Hg.
- Compared to adult haemoglobin (HbA), foetal haemoglobin (HbF) has higher affinity for oxygen (AIPMT 2009).

- People living at high altitudes have more number of RBC per microliter of blood (physiological polycythaemia; AIPMT 2006).
- Binding of oxygen with haemoglobin tends to displace  $CO_2$  from the blood. This is called the *Haldane effect*.
- When  $CO_2$  concentration in blood increases breathing becomes faster and deeper (hyperventilation) (AIPMT 2004).



Exercise

01. Which one of the following statements is incorrect?
- (1) Countercurrent flow of blood and water in gills of fishes enhances oxygenation.
  - (2) Most of the aquatic arthropods use special vascularized structures called gills for respiration.
  - (3) Larvae of amphibians perform branchial respiration.
  - (4) Arthropods use their cuticle for exchange of oxygen and carbon dioxide with the atmosphere.
02. Which one of the following groups of three animals is correctly matched with their respiratory organs?
- |     | Animals                       | Respiratory organ(s) |
|-----|-------------------------------|----------------------|
| (1) | Shark, snail, scorpion        | Gills                |
| (2) | Earthworm, tapeworm, silkworm | General body surface |
| (3) | Earthworm, frog, cockroach    | Skin                 |
| (4) | Crocodile, crow, cat          | Lungs                |
03. Trachea divides into primary bronchi at the level of
- (1) 5th thoracic vertebra
  - (2) 7th cervical vertebra
  - (3) 1st thoracic vertebra
  - (4) Diaphragm

04. Select the correct path of passage of air through the human respiratory tract.
- (1) Primary bronchiole → secondary bronchus → alveolar duct → alveolus
  - (2) Larynx → pharynx → trachea → bronchus → alveolus
  - (3) Secondary bronchus → primary bronchiole → terminal bronchiole → alveolus
  - (4) External nostril → pharynx → trachea → larynx → bronchus
05. Which of the following lacks cartilage?
- (1) Larynx
  - (2) Terminal bronchiole
  - (3) Trachea
  - (4) Tertiary bronchus
06. The figure shows a diagrammatic view of human respiratory system with labels A, B, C and D. Select the option that gives correct identification and main function or characteristic of one label.
- 
- (1) A: Epiglottis - Prevents the entry of food into the larynx
  - (2) B: Trachea - Lined by simple squamous epithelium
  - (3) C: Bronchus - Supported by incomplete cartilaginous rings
  - (4) D: Diaphragm - Contracts during expiration
07. Which of the following is not a function of the nose?
- (1) Warming and moistening the inhaled air
  - (2) Filtering dust particles from the inhaled air
  - (3) Detection of olfactory stimuli
  - (4) Exchange of respiratory gases

08. Which of the following is not correctly paired with its description?
- (1) Ventilation : Drawing of atmospheric air into the lungs and releasing  $CO_2$ -rich alveolar air outside
  - (2) Cellular respiration : Utilisation of  $O_2$  by the cells for anabolic reactions
  - (3) Pleural fluid : Reduces friction on the lung surface
  - (4) Spirometer : Used for measuring the volume of air involved in breathing
09. Select the correct statement about breathing in man.
- (1) Expiration is initiated due to the contraction of the diaphragm.
  - (2) Inspiration can occur if there is a negative pressure in the lungs with respect to atmospheric pressure.
  - (3) Contraction of the diaphragm increases the volume of the thoracic chamber in dorsoventral axis
  - (4) The anatomical setup of lungs in the thorax is such that any change in the lung volume will be reflected in the volume of the thoracic cavity.
10. Inspiration is initiated by the
- (1) Contraction of the diaphragm
  - (2) Relaxation of the diaphragm
  - (3) Contraction of the internal intercostal muscles
  - (4) Relaxation of the external intercostal muscles
11. Which of the following occurs during exhalation?
- (1) Diaphragm becomes arched upwards
  - (2) Ribs and sternum are raised up
  - (3) External intercostal muscles contract
  - (4) Negative pressure in the lungs with respect to atmospheric pressure
12. Tidal volume is about \_\_\_\_ percent of total lung capacity.



- (1) 14 (2) 20 (3) 3 (4) 8
13. Which of the following cannot be measured by normal spirometry?
- (1) Residual volume  
(2) Tidal volume  
(3) Inspiratory reserve volume  
(4) Vital capacity
14. Lung volumes of a person are given below.
- Tidal volume = 500 mL  
Inspiratory reserve volume = 1900 mL  
Expiratory reserve volume = 700 mL  
Residual volume = 1100 mL
- Calculate the inspiratory capacity of the person.
- (1) 3100 mL  
(2) 2400 mL  
(3) 4500 mL  
(4) 1200 mL
15. Volume of air that remains in the lungs after a normal expiration is termed
- (1) Residual volume  
(2) Expiratory reserve volume  
(3) Functional residual capacity  
(4) Vital capacity
16. The maximum volume of air a person can breathe in after a forced expiration is termed
- (1) Vital capacity  
(2) Total lung capacity  
(3) Expiratory capacity  
(4) Inspiratory capacity
17. Which of the following is true about lung volumes?
- (1) Residual volume > expiratory reserve volume  
(2) Residual volume < tidal volume  
(3) Inspiratory reserve volume = expiratory reserve volume  
(4) Tidal volume = residual volume
18. Which of the following pairs is correctly matched?
- (1) Vital capacity : ERV+IRV  
(2) Total lung capacity : VC + RV  
(3) Functional residual capacity: ERV + TV  
(4) Inspiratory capacity: TV + ERV

19. Match the items given in Column I with those in Column II and select the correct option given below:

Column I	Column II
a. Tidal volume	i. 2500 – 3000 mL
b. Inspiratory Reserve volume	ii. 1100–1200 mL
c. Expiratory Reserve volume	iii. 500 mL
d. Residual volume	iv. 1000 – 1100 mL
a b c d	
(1) i iv ii iii	
(2) iii ii i iv	
(3) iii i iv ii	
(4) iv iii ii i	

20. Listed below are four respiratory capacities (i-iv) of a normal human adult and four jumbled formulae.

i	Functional residual volume	TV+IRV+ERV+RV
ii	Total lung capacity	TV+IRV
iii	Inspiratory capacity	ERV+RV
iv	Vital capacity	TLC-RV

Which one of the following is the correct matching of two capacities and their formulae?

- (1) (ii) TV+IRV+ERV+RV (iii) ERV+RV  
(2) (iii) TV+IRV (iv) TV+IRV+ERV+RV  
(3) (i) TV+IRV (ii) ERV+RV  
(4) (iv) TLC-RV (i) ERV+RV

21. The exchange of gases in the alveoli of the lungs takes place by

- (1) Primary active transport  
(2) Secondary active transport  
(3) Simple diffusion  
(4) Facilitated diffusion

22. Which of the following are equal?

- (1)  $p\text{CO}_2$  in the alveoli and  $p\text{O}_2$  resting tissues  
(2)  $p\text{O}_2$  in the deoxygenated blood and  $p\text{CO}_2$  resting tissues  
(3)  $p\text{O}_2$  in the alveoli and  $p\text{O}_2$  in the oxygenated blood

(4)  $p\text{CO}_2$  in the carotid artery and  $p\text{CO}_2$  in the pulmonary artery

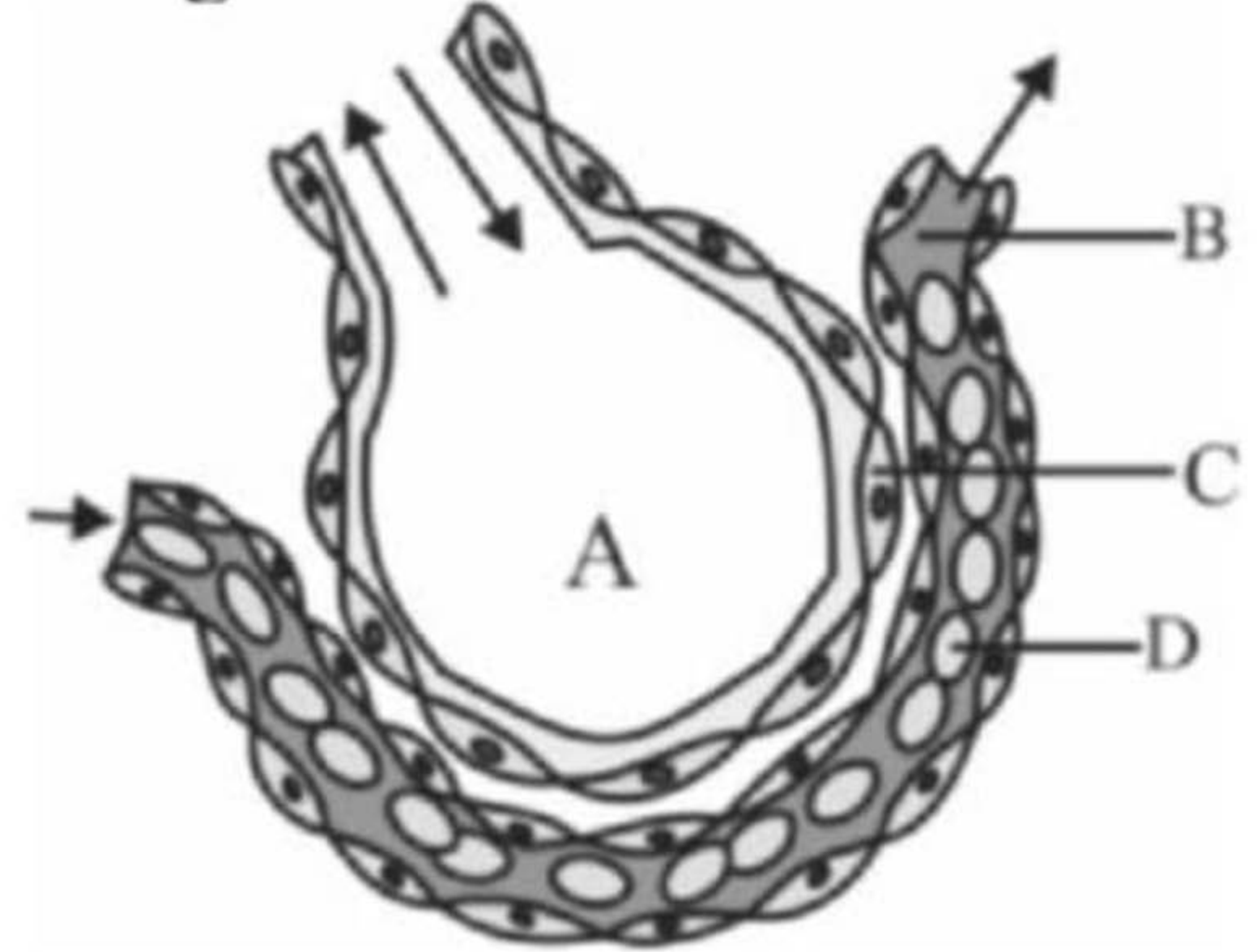
23. Choose the correct sequence representing the partial pressure of oxygen (in mm Hg) in atmospheric air, alveolar air, deoxygenated blood, oxygenated blood, and resting systemic tissues.

- (1) 159, 104, 40, 95 and 40  
(2) 0.3, 40, 45, 40 and 45  
(3) 159, 104, 40, 45 and 40  
(4) 0.3, 40, 40, 40 and 45

24. The amount of  $\text{CO}_2$  that can diffuse through the diffusion membrane per unit difference in partial pressure is much higher compared to that of  $\text{O}_2$  because

- (1) Molecular weight of  $\text{CO}_2$  is greater than that of  $\text{O}_2$   
(2)  $\text{CO}_2$  diffuses easily through gap junctions in the alveolar epithelium while  $\text{O}_2$  has to diffuse through tight junctions  
(3)  $\text{CO}_2$  is water-soluble whereas  $\text{O}_2$  is lipid-soluble  
(4) Solubility of  $\text{CO}_2$  is much higher compared to that of  $\text{O}_2$

25. The figure given below shows a small part of human lung where exchange of gases takes place. Select the option which represents a labelled part (A, B, C or D) correctly identified along with its feature.



- (1) C: Endothelium - Simple squamous epithelium  
(2) A: Alveolus - Only site of gas exchange  
(3) B: Capillary - Drains into pulmonary artery  
(4) D: Erythrocyte - Contains carbonic anhydrase

26. Which of the following is transported, at least partly, in a dissolved through the blood plasma?

- (1) Oxygen only  
(2) Both oxygen and carbon dioxide  
(3) Carbon dioxide only  
(4) Neither oxygen nor carbon dioxide

27. The majority of carbon dioxide produced by our body cells is transported to the lungs as

- (1) Carbaminohaemoglobin  
(2) Dissolved carbon dioxide  
(3) Bicarbonates  
(4) Carboxyhaemoglobin

28. The percentage of carbon dioxide that is transported from the tissues to the lungs as carbamino compounds is

- (1) 7  
(2) 20-25  
(3) 70  
(4) 3

29. Which of the following would decrease the affinity of haemoglobin for oxygen?

- (1) Low pH  
(2) Low temperature  
(3) Low BPG  
(4) Low  $\text{H}^+$  concentration

30. Which of the following is the best description of Bohr effect?

- (1) Increase in oxygen affinity of haemoglobin with falling blood pH  
(2) Binding of  $\text{H}^+$  converts hemoglobin to R state  
(3) Decrease in oxygen affinity of haemoglobin with falling blood pH  
(4) Increase in oxygen affinity of haemoglobin with increasing temperature

31. Which of the following is true about foetal haemoglobin (HbF)?

- (1) Its oxygen-haemoglobin dissociation curve is to the right of the curve for adult haemoglobin (HbA)  
(2) Its affinity for oxygen is higher than that of adult haemoglobin  
(3) It contains two alpha chains and two beta chains



- (4) It binds BPG more tightly than does adult haemoglobin
32. Which of the following best describes Hamburger's phenomenon?
- (1) Exchange of chloride and bicarbonate ions between the plasma and the RBCs
  - (2) Effect of carbon dioxide on the oxygen affinity of haemoglobin
  - (3) Oxygenation of haemoglobin in the lungs displaces carbon dioxide from the blood
  - (4) The amount of a gas that will dissolve in a liquid is proportional to the partial pressure of the gas and its solubility
33. Although  $H^+$  ions are produced in the RBCs in systemic capillaries, blood does not become too acidic because
- (1) Carbonic anhydrase enzyme is present in the RBCs
  - (2)  $H^+$  ions combine with  $HCO_3^-$  to form  $H_2CO_3$  in the systemic capillaries
  - (3) Chloride shift occurs in systemic capillaries
  - (4) Histidine residues in hemoglobin can accept protons and act as buffers
34. Carbonic anhydrase catalyzes the
- (1) Dissociation of  $H_2CO_3$  into  $CO_2$  and  $H_2O$  in systemic capillaries
  - (2) Dissociation of  $H_2CO_3$  into  $H^+$  and  $HCO_3^-$  in pulmonary capillaries
  - (3) Formation of  $H_2CO_3$  from  $CO_2$  and  $H_2O$  in systemic capillaries
  - (4) Formation of  $H_2CO_3$  from  $CO_2$  and  $H_2O$  in pulmonary capillaries
35. Every 100 ml of deoxygenated blood delivers approximately \_\_\_\_ mL of  $CO_2$  to the alveoli.
- (1) 5    (2) 4    (3) 3    (4) 2
36. The basic respiratory rhythm is established by a respiratory centre located in the
- (1) Pons
  - (2) Medulla oblongata
  - (3) Cerebellum
  - (4) Thoracic segment of the spinal cord
37. Neural signals from pneumotaxic centre
- (1) Reduce the duration of inhalation
  - (2) Increase the duration of inhalation

- (3) Reduce the breathing rate
  - (4) Increase the tidal volume
38. When you hold your breath, which of the following stimulus would first lead to the urge to breathe?
- (1) Falling  $O_2$  concentration in the blood
  - (2) Falling  $CO_2$  concentration in the blood
  - (3) Rising pH of the blood
  - (4) Rising  $CO_2$  concentration in the blood
39. Chemoreceptors that are involved in the regulation of pulmonary ventilation are associated with
- (1) Aortic arch and coronary arteries
  - (2) Pulmonary trunk and aortic arch
  - (3) Carotid artery and aortic arch
  - (4) Pulmonary artery and pulmonary vein
40. Pneumotaxic centre is located in the
- (1) Pons
  - (2) Medulla oblongata
  - (3) Cerebellum
  - (4) Hypothalamus
41. Select the correct statement.
- (1) Endocrine system directly modulates the respiratory rhythm to suit the demands of the body tissues.
  - (2) Intercostal muscles are skeletal muscles hence are purely voluntary in nature.
  - (3) The role of oxygen in the regulation of respiratory rhythm is quite insignificant.
  - (4) Respiratory rhythm centre is present in the cerebellum.
42. Asthma is due to
- (1) Damage to alveolar walls
  - (2) Inflammation of bronchi and bronchioles
  - (3) Streptococcal bacterial infection
  - (4) Paralysis of bronchial muscles
43. Pulmonary fibrosis is most commonly associated with
- (1) Asthma
  - (2) Emphysema
  - (3) Pneumonia
  - (4) Asbestosis
44. Which of the following options correctly represents the conditions in asthma and emphysema, respectively?

- (1) Nasal congestion; inflammation of bronchioles
  - (2) Spasm of bronchial muscles; increased respiratory surface
  - (3) Inflammation of bronchioles; decreased respiratory surface
  - (4) Decreased respiratory surface; Inflammation of bronchioles
45. Which of the following is not an occupational respiratory disorder?
- (1) Silicosis
  - (2) Anthracosis
  - (3) Siderosis
  - (4) Emphysema

## ANSWER KEY

1. 4	2. 4	3. 1	4. 3	5. 2
6. 3	7. 4	8. 2	9. 2	10. 1
11. 1	12. 4	13. 1	14. 2	15. 3
16. 1	17. 1	18. 2	19. 3	20. 4
21. 3	22. 1	23. 2	24. 4	25. 4
26. 2	27. 3	28. 2	29. 1	30. 3
31. 2	32. 1	33. 4	34. 3	35. 2
36. 2	37. 1	38. 4	39. 3	40. 1
41. 3	42. 2	43. 4	44. 3	45. 4

## HINTS &amp; SOLUTIONS

01. Cutaneous respiration occurs in annelids; not arthropods. Aquatic arthropods respire through gills or book gills. Terrestrial arthropods respire through tracheae or book lungs.
02. Reptiles (e.g. crocodile), birds (e.g. crow) and mammals (e.g. cat) respire through lungs. Scorpion – book lungs (not gills); silkworm – tracheae (not body surface); cockroach – tracheae (not skin);
03. The trachea is a straight tube extending up to the mid-thoracic cavity, which divides at the level of 5th thoracic vertebra into a right and left primary bronchi.
04. External nostril → nasal chamber → internal

nostril → pharynx → glottis → larynx → trachea → primary bronchus → secondary bronchus → tertiary bronchus → primary bronchiole → secondary bronchiole → tertiary bronchiole → terminal bronchiole → respiratory bronchiole → alveolar duct → alveolar sac → alveolus.

05. The tracheae, primary, secondary and tertiary bronchi, and initial bronchioles are supported by incomplete cartilaginous rings.
06. The trachea, bronchi and initial bronchioles are supported by C-shaped (incomplete) cartilage rings. 'A' is not the epiglottis but the thyroid cartilage of the larynx. The trachea is lined by pseudostratified columnar ciliated epithelium (not simple squamous); The diaphragm contracts during inspiration but not expiration.
07. Exchange of gases occurs in the conducting part of the respiratory tract. The parts starting from the external nostrils up to the terminal bronchioles constitute the conducting part. The conducting part transports the atmospheric air to the alveoli, clears it from foreign particles, humidifies and also brings the air to body temperature.
08. Cellular respiration is the utilisation of  $O_2$  by the cells for catabolic reactions (not anabolic).
09. Inspiration can occur if the pressure within the lungs (intra-pulmonary pressure) is less than the atmospheric pressure, i.e., there is a negative pressure in the lungs with respect to atmospheric pressure.
10. Inspiration is initiated by the contraction of diaphragm which increases the volume of the thoracic chamber in the antero-posterior (vertical) axis.
11. During exhalation, the diaphragm relaxes and becomes arched upwards (Ref. Fig. 17.2, NCERT Class XII Textbook).
12. Tidal (500 mL) volume is about 8% of total lung capacity (about 6,000 mL).
13. Residual volume cannot be measured by spirometry because it is neither inhaled nor exhaled.



14. In that person:

$$IC = TV + IRV = 500 + 1,900 = 2,400 \text{ mL}$$

15. The volume of air that remains in the lungs after a normal expiration is termed functional residual capacity (FRC).  $FRC = ERV + RV$ .

16. Vital capacity is the maximum volume of air a person can breathe in after a forced expiration (or) the maximum volume of air a person can breathe out after a forced inspiration.

$$VC = ERV + TV + IRV$$

17.  $TV (500 \text{ mL}) < ERV (1000-1100 \text{ mL}) < RV (1100-1200 \text{ mL}) < IRV (2500-3000 \text{ mL})$

18.  $TLC = VC + RV$

$$VC = IRV + TV + ERV$$

$$FRC = ERV + RV$$

$$IC = TV + IRV$$

19.  $TV = 500 \text{ mL}$

$$IRV = 2500-3000 \text{ mL}$$

$$ERV = 1000-1100 \text{ mL}$$

$$RV = 1100-1200 \text{ mL}$$

20.  $FRC = ERV + RV$

$$TLC = TV + IRV + ERV + RV - (1)$$

$$IC = TV + IRV$$

$$VC = IRV + TV + ERV - (2)$$

From (1) and (2) we can derive that:

$$VC = TLC - RV$$

21.  $O_2$  and  $CO_2$  are exchanged through the diffusion membrane (respiratory membrane) by simple diffusion mainly based on pressure/concentration gradient.

22.  $pCO_2$  in the alveoli (40 mm Hg) =  $pO_2$  in the resting systemic tissues (40 mm Hg)

23.  $pCO_2$  at different parts is as follows:

Atmospheric air	-	0.3 mm Hg
Alveolar air	-	40 mm Hg
Deoxygenated blood	-	45 mm Hg
Oxygenated blood	-	40 mm Hg
Resting tissues	-	45 mm Hg

24. According to Henry's law, the amount of a gas that will dissolve in a liquid is proportional to the partial pressure of the gas and its solubility.

As the solubility of  $CO_2$  is 20-25 times higher than that of  $O_2$ , the amount of  $CO_2$  that can diffuse through the diffusion membrane per unit difference in partial pressure is much higher compared to that of  $O_2$ .

25. Carbonic anhydrase enzyme present in the erythrocytes catalyzes the formation of carbonic acid from  $CO_2$  and  $H_2O$  and its dissociation into  $H^+$  and  $HCO_3^-$  at tissues. It also catalyzes the reverse reactions at the lungs. 'C' is alveolar epithelium (not endothelium which is the epithelium of the blood capillary). Exchange of gases occurs not only in the alveoli but also in the respiratory bronchioles, alveolar ducts and at systemic tissues. Pulmonary capillary drains oxygenated blood into the pulmonary vein (not the pulmonary artery).

26. Three percent of  $O_2$  is carried in a dissolved state through the plasma. About 7 percent of  $CO_2$  is carried in a dissolved state through plasma.

27. 70 percent of  $CO_2$  is carried from the tissues to the lungs as bicarbonate.

28. About 20-25% of  $CO_2$  is transported from the tissue to the lungs by haemoglobin as carbamino haemoglobin.

29. Low  $pO_2$ , high  $pCO_2$ , Low pH (high  $H^+$ ) and high temperature favour dissociation of  $O_2$  from  $HbO_2$ . The effect of  $CO_2$  and  $H^+$  on the oxygen affinity of haemoglobin is termed Bohr effect.

30. The effect of  $CO_2$  and  $H^+$  on the oxygen affinity of haemoglobin is termed Bohr effect. high  $pCO_2$  and Low pH would decrease the oxygen affinity of haemoglobin and thus favour unloading of  $O_2$  from  $HbO_2$  at tissues.

31. The oxygen affinity of HbF is greater than that of HbA. Its oxygen-haemoglobin dissociation curve is to the left of the dissociation curve of HbA.

32. The exchange of  $Cl^-$  and  $HCO_3^-$  ions between the plasma and the RBC is called the chloride shift or Hamburger's phenomenon. In

systemic capillaries,  $CO_2$  enters the RBCs and reacts with  $H_2O$ , in the presence of carbonic anhydrase, to form  $H_2CO_3$  which dissociates into  $H^+$  and  $HCO_3^-$ . Some  $HCO_3^-$  diffuses out into the blood plasma, down its concentration gradient. The plasma membrane of the RBCs is nearly impermeable to cations. To maintain the electrical balance between blood plasma and RBCs,  $Cl^-$  move from the blood plasma into the RBC.

33. Histidine is a basic amino acid. Histidine residues in haemoglobin can accept  $H^+$  and act as buffers.

34. At the tissues, carbonic anhydrase enzyme present in the erythrocytes catalyzes the formation of  $H_2CO_3$  from  $CO_2$  and  $H_2O$  and its dissociation into  $H^+$  and  $HCO_3^-$  at tissues. At the alveoli, it catalyzes the formation of  $H_2CO_3$  from  $H^+$  and  $HCO_3^-$  its dissociation into  $CO_2$  and  $H_2O$ .



35. Every 100 mL of deoxygenated blood delivers approximately 4mL of  $CO_2$  to the alveoli.

36. A specialised centre present in the medulla region of the brain called respiratory rhythm centre is primarily responsible for the regulation of respiratory rhythm. The pneumotaxic centre present in the pons can moderate the functions of the respiratory rhythm centre.

37. Neural signals from the pneumotaxic centre can reduce the duration of inspiration and there by alter (reduce) the respiratory rate.

38. A chemosensitive area is situated adjacent to the rhythm centre as well as the chemoreceptors associated with aortic arch and carotid artery are highly sensitive to  $CO_2$  and  $H^+$ . Increase in  $CO_2$  and  $H^+$  signal the rhythm centre to make necessary adjustments in the respiratory process by which these substances can be eliminated. The role of oxygen in the regulation of respiratory rhythm is quite insignificant.

39. Receptors associated with aortic arch (aortic bodies) and carotid artery (carotid bodies) can recognise changes in  $CO_2$  and  $H^+$  concentration and send necessary signals to the rhythm centre for remedial actions.

40. The pneumotaxic centre is present in the pons. It can moderate the functions of the respiratory rhythm centre. Neural signals from the pneumotaxic centre can reduce the duration of inspiration and there by alter (reduce) the respiratory rate.

41. The role of oxygen in the regulation of respiratory rhythm is quite insignificant. Human beings have a significant ability to maintain and moderate the respiratory rhythm to suit the demands of the body tissues. This is done by the neural system (not the endocrine system). Though intercostal muscles and diaphragm are skeletal muscles, they have both voluntary and involuntary controls (breathing is involuntary most of the time). Respiratory rhythm centre is present in the medulla oblongata (not the pons).

42. Asthma is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles.

43. In case of occupational respiratory disorders (asbestosis, silicosis, etc.) prolonged exposure to dust can give rise to inflammation leading to fibrosis (proliferation of fibrous tissues) and thus causing serious lung damage.

44. Asthma – inflammation of bronchioles

Emphysema – decreased respiratory surface

45. Occupational lung diseases are work-related lung conditions that have been caused or made worse by the materials a person is exposed to within the workplace (e.g. silicosis, asbestosis, anthracosis, siderosis, etc.). Emphysema is not an occupational respiratory disorder. Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased. One of the major causes of emphysema is cigarette smoking.



(NES) .....A competitive edge for cracking NEET

# NEET Edge Series

## Strategies For Enhancement In Food Production (Animal Breeding), Organisms & Population

### Strategies For Enhancement In Food Production (Animal Breeding)

#### 1. Consider the following

- i. Homozygosity
- ii. Heterozygosity
- iii. Fitness

When an animal population is subjected to cross breeding which of the above is/are reduced?

- (a) i only
- (b) ii & iii only
- (c) i & iii only
- (d) i, ii & iii

#### 2. Outcross is an individual produced from mating between which of the following?

- (a) Same breed and closely related individuals
- (b) Different breed and closely related individuals
- (c) Same breed and not closely related individuals
- (d) Different breeds and not closely related individuals

#### 3. Reduced fertility and productivity in animals due to continued inbreeding can be overcome by

- (a) Mating superior males of one breed with superior females of other breed.
- (b) Mating animals within same breed but having no common ancestors for upto 4-6 generations.

(c) Mating between animals of same breed for 4-6 generations.

(d) Mating between male and female animals of two different species.

#### 4. Choose incorrect statement regarding multiple ovulation embryo transfer technology (MOET)

- (a) It is a controlled breeding experiments
- (b) This technique is applied only to increase hybrid production rate
- (c) FSH hormone is given to the cattle for follicular maturation and superovulation
- (d) Semen of superior male is collected and injected into the reproductive tract of selected female with desirable traits

#### 5. Which of the following is/are important species of honeybee utilised in apiculture are

- i. Apis mellifera
- ii. Apis indica
- iii. Apis dorsata
- iv. Apis florea
- (a) i, ii
- (b) i, ii & iii
- (c) i, ii, iii, iv
- (d) ii & iv

#### 6. Which one of the following is arrhenotoky?

- (a) Drones are male honeybees which develop from unfertilised eggs.
- (b) Haploids individuals develop from parthenogenesis.
- (c) Drones are female honey bees which develop from fertilised eggs.

(d) Drones are sterile honeybees and

#### 7. Which of the following procedures is/are followed in dairy farm management?

- i. usage of manure to increase crop yields
- ii. regular inspections and visits by veterinary doctors
- iii. adequate environmental condition is provided
- iv. weeding away unproductive and harmful plants from the brood house.

- (a) i and ii are correct
- (b) ii and iii are correct
- (c) iii and iv are correct
- (d) i and iii are correct

#### 8. Which of the following points should be kept into consideration for successful bee keeping?

- i. light management according to the habits of honeybees
- ii. selection of suitable location for keeping the beehives
- iii. knowledge of the behaviour of honey bees
- iv. handling and collection of honey and bee wax.

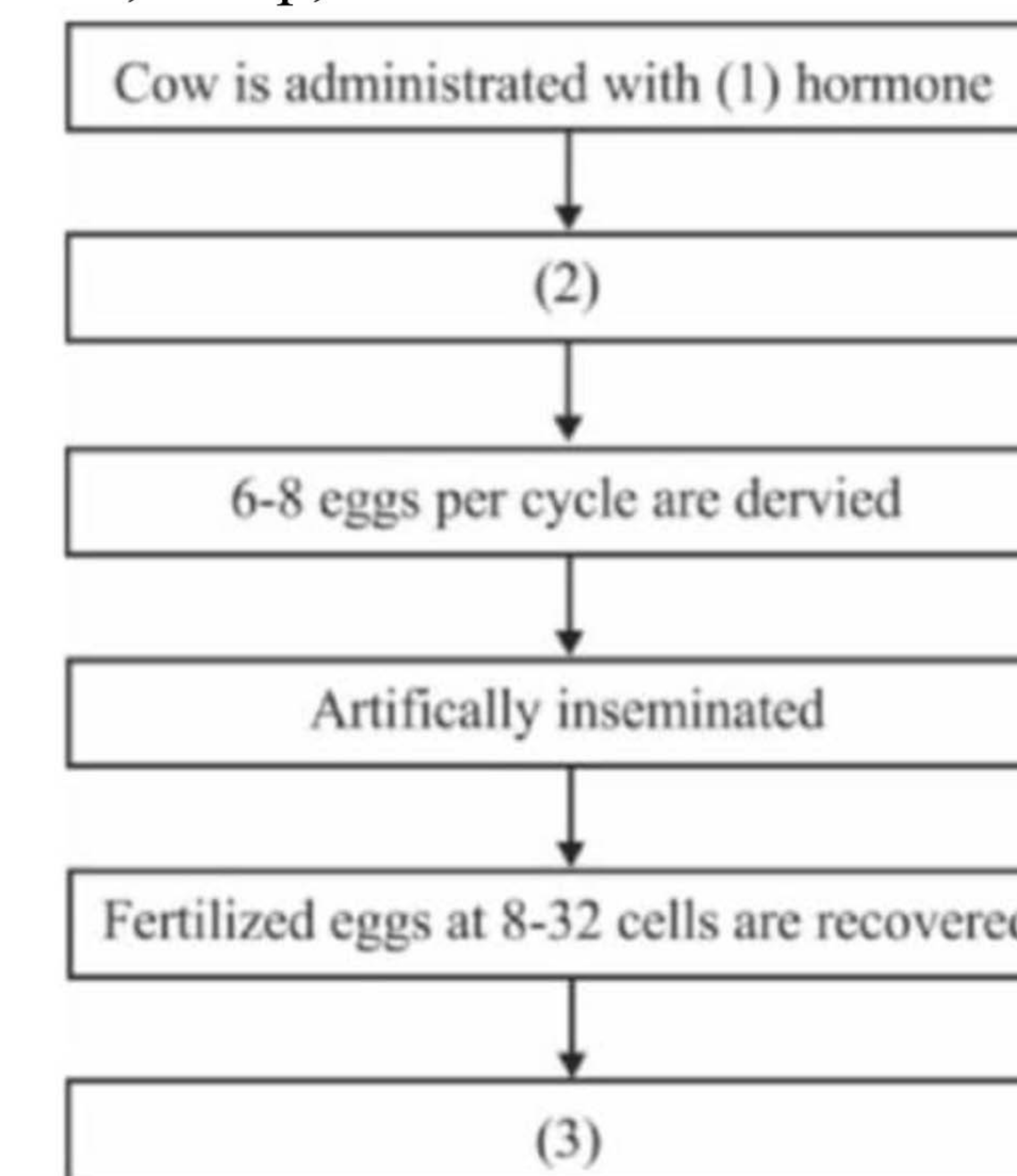
- (a) i, ii, iii
- (b) i, iii, iv
- (c) i, ii, iii, iv
- (d) ii, iii, iv

#### 9. Identify the true statements-

- i. Pullorum disease of poultry is caused by virus.
- ii. Drones are produced by parthenogenesis.
- iii. Heterosis or hybrid vigour is the phenotypic superiority of the hybrid over either of its parents in one or more traits.
- iv. A clone contains and expresses genetically engineered gene known as transgene.
- v. Cross breeding is practiced to develop homozygous pureline.

- (a) i, iv and v
- (b) ii and iii
- (c) All
- (d) None

#### 10. Following methodology has been used for cattle, sheep, buffaloes etc.



- (a) 1-LH, 2-Superovulation due to induced follicular maturation, 3- Transfer to surrogate mother
- (b) 1-FSH, 2-Superovulation due to induced follicular maturation, 3- transfer to surrogate mother
- (c) 1-progesterone, 2-Superovulation due to induced follicular maturation, 3-Transfer to surrogate mother
- (d) 1-Estrogen, 2-superovulation due to induced follicular maturation, 3-Transfer to surrogate mother

### Organisms and Population

#### 1. The most striking difference between tropical rain forest and temperate forest is that

- (a) The tropical rain forests have preponderance of angiosperms while the temperate one have preponderance of gymnosperms
- (b) The trees of temperate forest are taller than those of tropical rain forests
- (c) Giants of temperate forests are comparatively mesophytic
- (d) Tropical forests are comparatively more mesogenic

#### 2. Some organisms are able to maintain homeostasis by physiological (sometimes



behavioural also) means which ensure constant body temperature, constant osmotic concentration etc. are called

- (a) Regulators (b) Conformers  
(c) Parasites (d) Predator

3. Thermoregulation is energetically expensive for many organisms particularly

- (a) Small animals (b) Shrews  
(c) Humming birds (d) All the above

4. If the stressful external condition are localised or remain only for a short duration, the organism has some alternatives like

- (a) Regulate (b) Conform  
(c) Migrate (d) Suspend

5. In polar seas, aquatic a like b have a thick layer of fat called c below their skin that acts as an d and reduces loss of body heat.

- (a) a- fishes, b-sharks, c-clasper, d-conductor  
(b) a-mammals, b-seals, c-blubber, d-insulator  
(c) a-fishes, b-seals, c-blubber, d-insulator  
(d) a- mammals, b-seals, c- blubber, d-conductor

6. In higher plants, which structure serve as means to tide over period of stress and also helps in dispersal

- (a) Seed  
(b) Vegetative reproductive structures / propagules  
(c) both (a) and (b)  
(d) Spores

7. Read the following statements and find out the incorrect statement

- (a) Microbes / archaeobacteria flourish in hot springs and deep sea hydrothermal vents where temperature exceed  $100^{\circ}\text{C}$   
(b) Many fish thrive in Antarctic waters where the temperature is always below zero  
(c) A large variety of marine invertebrates and fish live at great depths in the ocean where the pressure could be  $>100$  times than the normal atmospheric pressure  
(d) Desert lizard have physiological ability that mammals have to deal with high temperature of their habitat

8. If a population growing exponentially doubles in size in 3 years, what is the intrinsic rate of increase (r) of the population? ( $\log_{10} e = 0.434$ )

- (a) 0.231 (b) 0.168 (c) 0.173 (d) 0.184

9. In a laboratory there are 40 fruit flies last week and during experiment 4 fruit flies died in a week. Calculate the death rate.

- (a) 0.1 individual per fruitfly per year  
(b) 0.36 individual per fruitfly per week  
(c) 0.4 individual per fruitfly per week  
(d) 0.1 individual per fruitfly per week

10. In a population showing logistic growth,  $r = 0.15$  per capita per year and the carrying capacity of the habitat is 2,000 individuals. What is the population growth rate ( $dN/dt$ ) when the number of individuals (N) in the population is 1200?

- (a) 120 (b) 180 (c) 72 (d) 80

11. No predator can become proficient at acquiring prey because \_\_\_\_\_

- (a) Predators are too large to be fast enough  
(b) Prey populations evolve antipredatory traits  
(c) Prey populations evolve more rapidly than predator populations  
(d) Predators are not as intelligent as their prey

12. Choose the correct sequence of stages of growth curve for bacteria :

- (a) Lag, log, stationary, decline phase  
(b) Lag, log, stationary phase  
(c) Stationary, lag, log, decline phase  
(d) Decline, lag, log phase

13. In 2000, for each of the 14 million people present in a country, 0.036 were born and 0.016 died during the year. Using exponential equation, the number of people present in 2010 is predicted as

- (a) 14 million (b) 2.8 million  
(c) 16.8 million (d) 0.20 million

14. How many insects are known to be phytophagous

- (a) 25% (b) 50% (c) 50% (d) 18%

15. Which one provide the evidence for the occurrence of competition in nature?

- (a) Resource partitioning  
(b) Competitive release  
(c) Mac Arthur experiment  
(d) All of the above

16. Which of the following best describes the principle of competitive exclusion in wake of Mac Arthur's findings?

- (a) Competition between two species causes extinction of one species  
(b) Two species occupying exactly the same niche cannot coexist in a community  
(c) Competition in a population decreases survival of the best- adapted individuals  
(d) No two species can coexist in the same habitat

17. The feeding efficiency of one species might be reduced due to the interfering and inhibitory presence of the other species, even if resources are abundant then it is called

- (a) Resource partitioning  
(b) Competitive release  
(c) Interference competition  
(d) Competitive exclusion

18. When certain exotic species are introduced into a geographical area, they become invasive and spread because the invaded land does not have its natural

- (a) Competitor (b) Predator  
(c) Parasite (d) Symbionts

19. In estuaries, salinity levels typically decline in the rainy season and rise during the summer. Which organisms are adapted to live in such environments?

- (a) Stenohaline (b) Homeothermic  
(c) Euryhaline (d) Stenothermal

20. Which is not a characteristic of intestinal symbionts?

- (a) Feeding on extra food of host  
(b) Providing vitamins to host  
(c) Anaerobic respiration  
(d) Aerobic respiration

21. In an area there are 200 Parthenium plant but only a single huge banyan tree with a large canopy. The population density is measured in terms of

- (a) Number of biomass  
(b) Number of percent cover  
(c) Biomass or percent cover  
(d) Number, biomass or percent cover

22. The population has certain attributes which an organism or individual does not. These are

- i. Birth rate ii. Death rate  
iii. Sex ratio iv. Age distribution  
(a) i and ii (b) ii and iii  
(c) iii and iv (d) i, ii, iii and iv

23. The reason of the altitude sickness is

- (a) The low atmospheric pressure of high altitudes  
(b) The high atmospheric pressure of high altitudes  
(c) The low atmospheric temperature of high altitudes  
(d) Both (a) and (b)

24. A person experience altitude sickness when they go to any high place like Rohtang pass near Manali and Mansarovar in China occupied Tibet, above a height

- (a)  $> 3500$  m (b)  $> 3500$  feet  
(c)  $> 500$  m (d)  $> 500$  feet

25. Read the following statements and find out the incorrect statement

- (a) Mango tree do not and cannot grow in tropical countries like Canada and Germany  
(b) Snow leopards are not found in kerala forests  
(c) Tuna fish are rarely caught beyond tropical latitudes in the ocean  
(d) Both (a) and (c)

26. Though it is energetically expensive, tobacco plant produces nicotine because

- (a) It increases the taste of tobacco leaves  
(b) It stimulates the secretion of adrenaline  
(c) It decreases transpiratory water loss  
(d) It protects it from herbivores

27. Why does a bird sing?

- (a) Operating of the voice box  
(b) Vibrating  
(c) Bird needs to communicate with its mate during breeding season



- (d) Both (a) and (b)
28. Which of the following organisms are indeed capable of thermoregulation and osmoregulation?
- (a) All birds  
(b) All mammals  
(c) Very few lower vertebrate and invertebrate species  
(d) All the above
29. The adjustment of pupil of our eye to light intensity is an example of
- (a) Eutropy (b) Steady state  
(c) Adaptation (d) All of these
30. An ecosystem resist change because it is in a state of
- (a) Imbalance (b) Homeostasis  
(c) Shortage of light (d) Deficiency of light
31. A high density of Elephant population in an area can result in
- (a) Predation on one another  
(b) Mutualism  
(c) Intraspecific competition  
(d) Interspecific competition
32. Two opposite forces operate in the growth and development of every population. One of them is related to the ability to reproduce at a given rate. The force opposite to it is called
- (a) Fecundity  
(b) Mortality  
(c) Environmental resistance  
(d) Biotic control
33. Which plant is found in mangrove zone?
- (a) Rhizophora (b) Acacia  
(c) Pinus (d) Tectona grandis
34. In an animal population of 1,000 individuals showing exponential growth, birth rate is 0.15 per capita per year and death rate is 0.10 per capita per year. What will be the population size after 10 years? ( $e=2.72$ )
- (a) 1,500 (b) 1,649 (c) 1,964 (d) 7,398
35. During a study, a team of students captured 35 snails from a garden. They marked their shells with nail polish and released them back into the garden. A week later, they randomly

captured 24 snails from the garden, of which 12 were marked. What is the total number of snails in the pond?

- (a) 38 (b) 60 (c) 80 (d) 70

36. Verhulst-Pearl Logistic Growth is described by the equation

(a)  $\frac{dN}{dt} = rN \left[ \frac{K-N}{K} \right]$  (b)  $\frac{dN}{dt} = rN$

(c)  $\frac{K-N}{K}$  (d)  $N_t = N_0 e^{rt}$

### ANSWER KEY

#### Strategies For Enhancement In Food Production (Animal Breeding)

1. a 2. c 3. b 4. b 5. c  
6. a 7. b 8. d 9. b 10. b

#### Organisms and Population

1. a 2. a 3. d 4. c 5. b  
6. c 7. d 8. a 9. d 10. c  
11. b 12. a 13. c 14. a 15. b  
16. b 17. c 18. b 19. c 20. d  
21. c 22. d 23. a 24. a 25. a  
26. d 27. c 28. d 29. c 30. b  
31. c 32. c 33. a 34. b 35. d  
36. a

### HINTS & SOLUTIONS

#### Strategies For Enhancement In Food Production (Animal Breeding)

1. (a) When an animal population is subjected to cross breeding Heterozygosity and fitness are increased.
2. (c) Outcross is an individual produced from mating between same breed and not closely related individuals.
3. (b) Reduced fertility and productivity in animals due to continued inbreeding can be overcome by mating animals within same breed but having no common ancestors for up to 4-6 generations.

4. (b) Multiple ovulation embryo transfer technology (MOET) is a controlled breeding experiment.
5. (c) Four important species of honeybee utilised in apiculture are: *Apis mellifera*, *Apis indica*, *Apis dorsata*, *Apis florea*
6. (a) Arrhenotoky is a form of parthenogenesis in which unfertilized eggs develop into males.
7. (b) Statement A and D are related to agriculture and are completely unrelated to dairy management.
8. (d)
9. (b)
10. (b)

#### Organisms and Population

1. (a)
2. (a) Regulators are those organisms which regulate a constant body temperature
3. (d) Thermoregulation is energetically expensive process for many organisms. This is particularly true for small animals like shrews and hummingbirds. Heat loss or heat gain is a function of surface area. Since small animals have a larger surface area relative to their volume, they tend to lose body heat very fast when it is cold outside; then they have to expend much energy to generate body heat through metabolism. This is the main reason why very small animals are rarely found in polar regions.
4. (c) The organism can migrate away temporarily from the stressful habitat to a more hospitable area and return when stressful period is over.
5. (b)
6. (c)
7. (d)
8. (a) According to Exponential growth equation:
- $$N_t = N_0 e^{rt}$$
- where,  $N_t$  = Population density at time t.  
 $N_0$  = Population density at time zero  
 $r$  = Intrinsic rate of natural increase

$e$  = Base of natural Logarithms (2.718)

$t$  = 3 years

Now, present population density =  $x$

Population density after 2 yrs =  $2x$

So,  $2x = xe^{3r}$

Applying log on both sides

$$\Rightarrow \log 2 = 3r \log e$$

$$\Rightarrow \frac{\log 2}{3 \log e} = r$$

$$\Rightarrow \frac{\log 2}{3 \times 0.434} = r$$

$$\Rightarrow 0.2311 = r$$

9. (d) The death rate in the population during that period is  $4/40 = 0.1$  individuals per fruitfly per week.

$$\begin{aligned} \frac{dN}{dt} &= rN \left( \frac{K-N}{K} \right) \\ 10. (c) &= 0.15 \times 1200 \left( \frac{2000-1200}{2000} \right) \\ &= 180 \left( \frac{800}{2000} \right) = 80 \left( \frac{2}{5} \right) \\ &= 72 \end{aligned}$$

11. (b) Predator & Prey both evolve to achieve their goals.

12. (a) Bacterial growth curve shows lag, log, stationary and decline phase.

13. (c) Exponential equation

$$dN \cdot dt = (b-d) \times N$$

$$dN/dt = (0.036 - 0.016) \times 14$$

$$= 0.020 \times 14$$

$$dN/10 = 0.28$$

$$dN = 0.28 \times 10$$

$$dN = 2.8$$

So, 14 million + 2.8 million = 16.8 million

14. (a) Phytophagous are the insects which feed on plant sap and other parts of the plants. Nearly 25% of the insects belong to this group and it is estimated to be approximately 5,00,000 insects.

15. (b) Competitive release is a situation in which an organism is relieved of the stresses associated with competition.

16. (b) Overlapping of niches of two species



results in competition, which may lead to competitive exclusion. Competitive exclusion may be avoided if the competing species evolves to use different resources, occupy different areas of the habitat, or feed during different time of day. Mac Arthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities.

**17.(c)** In competition, organisms use up resources directly. Once used, the resource is no longer available for other species to use. In interference competition, one organism prevents other organisms from using the resource.

**18.(b)** Newly invaded exotic species will not be having its natural predator hence, it multiplies at a faster rate

**19. (c)** Euryhaline organisms can tolerate wide range of salinities.

**20.(d)** Intestinal symbionts exist inside our body. There is no availability of oxygen hence, they are not able to perform aerobic respiration.

**21.(c)** In case of Parthenium plants and banyan tree, the percent cover or biomass is a more meaningful measure of the population size.

**22.(d)** Population is a group of individuals of same species living together in a habitat, which have certain characteristic like birth rate, death rate, age distribution and sex ratio.

**23.(a)** At high altitudes there will be low atmospheric pressure

**24.(a)** Altitude sickness is also called acute mountain sickness. It is a negative health effect on high altitudes above 3500m.

**25.(a)**

**26. (d)** The problem of predation is particularly severe for plants because, unlike animals, they cannot run away from their predators. Therefore, plants have morphological and chemical defences against herbivores. Many plants produce and store chemicals

that make the herbivore sick when they are eaten, inhibit feeding or digestion, disrupt its reproduction or even kill it. Examples: cardiac glycosides, nicotine, caffeine, quinine, strychnine, opium.

**27. (c)**

**28. (d)**

**29. (c)** The pupil is an opening that lets light into your eye. Since most of the light entering your eye does not escape your pupil appears black. In dim light your pupil expands to allow more light to enter your eye, in bright light it contracts.

**30.(b)** Homeostasis is a state of maintaining a constant environment inside our body.

**31.(c)** Intraspecific competition is the competition occurring between the same species hence there will be more number of same species in an area.

**32.(c)** The environmental factors which can check the of growth population size constitute the environmental resistance.

**33.(a)** Rhizophore is a genus of Tropical mangrove trees.

**34. (b)**  $r = (b-d) = 0.15-0.1$

$$= 0.05$$

$$N_t = N_0 e^{rt}$$

$$= 1000 \times 2.72^{0.05 \times 10}$$

$$= 1000 \times 2.72^{0.5}$$

$$= 1000 \times \sqrt{2.72}$$

$$= 1000 \times 1.649 = 1649$$

**35.(d)** Mark and recapture method is used to estimate population size of animals.

$$\frac{\text{Number marked in the first catch (M)}}{\text{Total population (N)}} = \frac{\text{Number marked in the second catch (m)}}{\text{Total number of second catch (n)}}$$

$$\frac{M}{N} = \frac{m}{n}$$

$$N = \frac{m}{n} \times \frac{35 \times 24}{12} = 70$$

**36. (a)**

## CLASS XI

# BIOLOGY KVPY-7

## PREVIOUS YEAR QUESTIONS

### Animal Kingdom

- If birds are moved from 30°C to 10°C, their body temperature: [2009]
  - Changes from 30°C to 10°C,
  - Increases by 10°C
  - Does not change at all
  - Decreases by 10°C
- Unlike humans, dogs cannot perspire to get to excess metabolic heat. They lose metabolic heat by: [2009]
  - Panting
  - Running in windy conditions
  - Taking a bath
  - Rolling in the mud

### Cell-The Unit of Life

- Proteins are synthesized on: [2009]
  - Cytoskeleton
  - Mitochondria
  - Ribosomes
  - Golgi apparatus
- If the analogy of a city is applied to a eukaryotic cell then which of the following statements is correct? [2008]
  - Nucleus as a library and mitochondria as powerhouse
  - Nucleus as a police station and mitochondria as powerhouse
  - Mitochondria as powerhouse and golgi as a cargo sorting facility
  - Mitochondria as powerhouse and nucleus as slaughter house
- You have a tube containing  $10^2$  bacteria. You have taken out  $10^2$  bacteria. How many bacteria are left in the tube? [2008]
  - Approximately  $10^7$
  - Approximately  $10^6$
  - Approximately  $10^5$
  - Approximately  $10^9$

### Biomolecules

- Ascorbic acid is a/an [2009]
  - Strong inorganic acid
  - Hormone
  - Vitamin
  - Enzyme
- You are synthesizing a 5 amino acid containing peptide from the pool of 20 standard amino acids by choosing amino acids randomly. What is the probability of selecting Gly-Gly-Gly - Gly [2008]
  - 0
  - $1/20^5$
  - $1/20$
  - $1/(20 \times 5)$
- On a normal sunny day, rate of photosynthesis (per unit time) is maximum during : [2007]
  - Early morning
  - Between late morning to before noon
  - Midday
  - Late evening

### Photosynthesis in Higher Plants

- During photosynthesis, light energy: [2007]
  - Is converted to chemical energy
  - Is converted to kinetic energy
  - Is the catalyst
  - Dissociates  $\text{CO}_2$  directly

### Plant Growth & Development

- Seedling grown in dark are: [2009]
  - Similar to those grow in light
  - taller than those grow in light
  - Shorter than those grow in light
  - They don't grow at all
- If you put a nail at the middle of a young plant and allow it to grow, then: [2007]
  - You will find the nail at the same position after the tree is fully grown
  - The nail will fall out



- (c) The nail will rise along with the tree  
(d) The nail will come closer to the ground

### Respiration in Plants

1. The amount of  $\text{CO}_2$  plant is greater at night than during the day because: [2008]  
(a) The rate of respiration is higher at night.  
(b) More  $\text{CO}_2$  is produced because it is colder during the night.  
(c) Photosynthesis during the day uses up some of the  $\text{CO}_2$  produced by respiration.  
(d) More glucose is available for respiration during the night

### Mineral Nutrition

1. Rotation of crops is carried out to: [2009]  
(a) Increase variation in the mineral content of the soil  
(b) Increase diversity of plant habitats  
(c) Increase in nitrogen content of the soil  
(d) Increase convenience for the farmer

### Locomotion & Movement

1. A swimmer crossing the British channel after 2hrs of vigorous swimming experience severe muscle armors and is forced to discontinue. Which of the following options given below could give rise to this problem: [2007]  
(a) Muscle tear  
(b) Sea winter diffusion into muscles  
(c) Bite of piranhas  
(d) Lactic acid accumulation

### Digestion & Absorption

1. Bile salts: [2009]  
(a) Break down polypeptide chains  
(b) Emulsify fats and solubilize them  
(c) Digest fats  
(d) Help breakdown of polysaccharides  
2. Dietary fibers are composed of: [2009]  
(a) Cellulose  
(b) Amylase  
(c) Proteins  
(d) Unasturated fats

3. In the lunch, you ate boiled green vegetables, a piece of cooked meat, one boiled egg and a sugar candy. Which one of these [2008]

- (a) Boiled green vegetables  
(b) The piece of cooked meat  
(c) Boiled egg  
(d) Sugar candy

4. Diet rich in carotenoids is beneficial because: [2008]

- (a) They act as free radical scavengers  
(b) They absorb harmful UV rays  
(c) They help in curing cancer  
(d) They are rich source of iron

5. Partial removal of liver is not harmful because: [2007]

- (a) Liver being a large organ can suffice the functions even if a part is removed  
(b) Liver is not a very essential organ of the body  
(c) Liver has regenerative capacity and will grow after partial hepatectomy  
(d) The function of liver can be taken over by kidneys

### Body Fluids & Circulation

1. Saturated dietary fats increase the risk of heart disease by: [2009]

- (a) Widening arteries by thinning their wallls  
(b) Narrowing veins by carbohydrate deposition  
(c) Narrowing arteries by fat deposition  
(d) Narrowing arteries by carbohydrate deposition

2. An individual has O blood group if his/ her blood sample. [2009]

- (a) Clumps only when antiserum A is added  
(b) Clumps only when antiserum B is added  
(c) Clumps when both antiserum A and antiserum B are added  
(d) Does not clump when either antiserum A or antiserum B is added

3. In human, Rhesus conditions can arise when: [2009]

- (a) Father is  $\text{Rh}^+$  and mother is  $\text{Rh}^-$

- (b) Father is  $\text{Rh}^-$  and mother is  $\text{Rh}^-$   
(c) Either father or mother is  $\text{Rh}^+$   
(d) Either father or mother is  $\text{Rh}^-$

4. Arteries do not have valves but veins do, because: [2008]

- (a) Arteries have a narrower lumen than veins  
(b) Arteries have thicker walls than veins  
(c) Arteries carry oxygenated blood whereas veins carry deoxygenated blood  
(d) Valves prevent back flow of blood in veins

### Excretory Products & Their Elimination

1. Haemodialysis is a treatment option for patients with malfunctions of: [2009]

- (a) Kidney (b) Heart  
(c) Liver (d) Lungs

### Neural Control Coordination

1. Which of the following allows light to focus in visual perception? [2009]

- (a) Retina (b) Retinal pigment  
(c) Iris (d) Cornea

2. The part of the human brain that governs memory and intelligence is: [2009]

- (a) Cerebrum (b) Hypothalamus  
(c) Medulla (d) Cerebellum

3. If a person's spinal cord is injured, which of the following functions might be affected? [2008]

- (a) Talking (b) Seeing  
(c) Sneezing (d) Hearing

### Chemical Coordination & Integration

1. The appropriate description of animal hormones is, [2008]

- (a) Have size smaller than 5 kDa  
(b) Comprise of proteins only  
(c) Comprise of lipid molecule only  
(d) Are pour directly into the blood

### Principles of Inheritance & Variation

1. Alleles are: [2008]

- (a) Different forms of the same protein  
(b) Two different genes  
(c) Different forms of the same gene  
(d) Two different proteins

2. A couple has 8 children, all boys. What is the chance that their ninth child will be another boy? [2007]

- (a)  $1/2$  (b)  $1/4$  (c)  $1/8$  (d)  $1/16$

### Human Reproduction

1. The placenta tissue in mammals originates from: [2008]

- (a) The mother only  
(b) The foetus only  
(c) Both the mother and the foetus  
(d) Originates from the mother but taken over by the foetus

### Evolution

1. 'On the origin of species, by means of natural selection' was written by. [2009]

- (a) Hugo de Vries  
(b) Charles Darwin  
(c) Charles Dickens  
(d) Alfred Russell Wallace

2. Discovery of fossils has provided biologists with significant clues as in the steps in evolutions. Archaeopteryx one such example, which is connection link between: [2007]

- (a) Pisces and amphibian  
(b) Amphibia and reptilia  
(c) Reptilia and aves  
(d) Aves and mammalian

### Human Health & Diseases

1. Why is it advisable to take antibiotics if someone is suffering from gastric ulcers? [2008]

- (a) Antibiotics reduce gastric acid secretion  
(b) Antibiotics prevent ulcers from being infected  
(c) Antibiotics reduce gastric enzyme secretion  
(d) Gastric ulcers are caused by bacteria

2. A cancer which is not a tumor is: [2008]



- (a) Lymphoma (b) Leukemia  
(c) Prostate cancer (d) Oral cancer
3. A patient given broad spectrum antibiotic suffered from vitamin deficiency because:

[2007]

- (a) Antibiotic inactivated the vitamins  
(b) Antibiotic inhibited the synthesis of vitamins  
(c) Antibiotic killed the commensals in the gut which produced vitamins  
(d) Antibiotics killed the vitamin producing cells in liver
4. In a wound 'pus' is a:
- (a) A mixture of destroyed germs, killed leucocytes and damaged tissue cells  
(b) Concentrated blood plasma  
(c) Thick mucus secretion  
(d) Concentrated secretion of the sebaceous gland
5. Which of the following is a bacterial disease?
- (a) Smallpox (b) Measles  
(c) Meningitis (d) Rabies

### Strategies for Enhancement in Food Production (Animal Breeding)

1. In warmer weather, curds from milk forms faster because:
- (a) Bacteria diffuse better in warmer milk  
(b) The rate of bacterial multiplication increases  
(c) Lactogen is better dissolved  
(d) It is easier to separate protein from water
2. Majority of the world population depends largely on the following for their staple food:
- (a) Fungi and algae  
(b) Animal products  
(c) Dicotyledenous  
(d) Monocotyledenous plants

### Biodiversity & Conservation

1. Use of an insecticide in an island made a certain insect species extinct. A few years later a tree species was also found to be extinct. this may be because:

[2008]

- (a) The tree is pollinated by the insect  
(b) The insect used to live on the tree  
(c) The insect used to eat the leaves of the tree  
(d) The tree is insectivorous

### Organisms & Population

1. Similar type of vegetation can be observed, in the same ?
- (a) Latitude (b) Longitude  
(c) Country (d) Continent

[2009]

### Ecosystem

1. Which of the following ecological food chain does not represent an erect pyramid of numbers?
- (a) Grass-rodent-snake  
(b) Tree-bird-avian parasite  
(c) Grass-deer-Tiger  
(d) Insect-chicken-Human

[2009]

### Miscellaneous

1. If you are asked to write on a topic of interest, you can read as many book as you want but never copy someone else's writing on the same topic. the act is called plagiarism and is morally incorrect, as:
- (a) You are stealing someone else's labor  
(b) It is a punishable offence in cancer  
(c) You have not paid monry to do so  
(d) A patent exists on the writing

[2007]

### ANSWER KEY

#### Animal Kingdom

1. c 2. a

#### Cell-The Unit of Life

1. c 2. c 3. b

#### Biomolecules

1. c 2. b 3. b

#### Photosynthesis in Higher Plants

1. a

### Plant Growth & Development

1. b 2. a

### Respiration in Plants

1. c

### Mineral Nutrition

1. c

### Locomotion & Movement

1. d

### Digestion & Absorption

1. b 2. a 3. d 4. a, c 5. c

### Body Fluids & Circulation

1. c 2. d 3. a 4. d

### Excretory Products & Their Elimination

1. a

### Neural Control Coordination

1. d 2. a 3. c

### Chemical Coordination & Integration

1. d

### Principles of Inheritance & Variation

1. c 2. a

### Human Reproduction

1. c

### Evolution

1. b 2. c

### Human Health & Diseases

1. d 2. b 3. c 4. a 5. c

### Strategies for Enhancement in Food Production (Animal Breeding)

1. b 2. d

### Biodiversity & Conservation

1. a

### Organisms & Population

1. a

### Ecosystem

1. b

### Miscellaneous

1. a

### HINTS & SOLUTIONS

#### Animal Kingdom

**1.Sol:** Thermoregulation is the ability of an organism to keep its body temperature within certain limits, even when the surrounding temperature is very different. Thus, the ability to maintain a high and constant body temperature enables birds to exploit a remarkable range of habitats.

**2.Sol:** Dogs use body insulation and evaporative mechanisms, such as sweating and panting to regulate their body temperature.

#### Cell-The Unit of Life

**1.Sol:** Ribosomes are the site of protein synthesis in a cell. Hence its called proteins factory.

**2.Sol:** If cell is considered as an analogy of a city then, mitochondria can be considered as the powerhouse supplying power or energy whereas, Golgi apparatus can be considered as the cargo sorting facility as it facilitates the transport of proteins and necessary nutrients to other parts of the cell.

**3.Sol:** All bacteria have certain generation time where they produce new cells. In this question there is no time given. Data insufficient.

#### Biomolecules

**1.Sol:** Vitamin C is also known as ascorbic acid.

**2.Sol:** Since, there are 20 essential amino acids that code for DNA codons hence the probability of selecting glycine would be 1/205.

**3.Sol:** The main factors affecting rate of photosynthesis are light intensity, carbon dioxide concentration and temperature. The net photosynthetic rate under natural sunlight intensity increases from sunrise, reaches a maximum at mid-morning, and then shows midday depression.



### Photosynthesis in Higher Plants

- 1.Sol:** During photosynthesis the light energy from the sun is converted to chemical energy which is stored in the form of starch.

### Plant Growth & Development

- 1.Sol:** The stems of plants raised in the dark elongate much more rapidly than normal, this phenomenon is called etiolation.
- 2.Sol:** The nail will remain at the same position after the tree is fully grown because the growth in plants occurs on the apical region or apex of the stem where the meristematic cells are found.

### Respiration in Plants

- 1.Sol:** Plants produce carbon dioxide all the time because of respiration, but during the day (when there is light), they use  $\text{CO}_2$  for photosynthesis, and fix  $\text{CO}_2$  into other molecules, giving as end product  $\text{O}_2$  more than  $\text{CO}_2$ .

### Mineral Nutrition

- 1.Sol:** Crop rotation helps to replenish nutrients to the soil. A traditional element of crop rotation is the replenishment of nitrogen through the use of green manure in sequence with cereals and other crops.

### Locomotion & Movement

- 1.Sol:** Muscle fatigue and soreness in the muscles during intense exercise like swimming or running is a result of lactic acid build up.

### Digestion & Absorption

- 1.Sol:** Bile salts help with the digestion of fats in our bodies. They solubilize the ingested fat and fat-soluble vitamins, facilitating their digestion and absorption.
- 2.Sol:** Dietary fiber consists of plant components such as cellulose, inulin, lignins, chitins, pectins, beta-glucans, etc.
- 3.Sol:** Sugar candy is sugar which is a carbohydrate. Digestion of carbohydrates starts in the mouth itself with the help of saliva.

- 4.Sol:** Dietary carotenoids are thought to provide health benefits in decreasing the risk of disease, particularly certain cancers and eye disease. Carotenoids are some of nature's best antioxidants.

- 5.Sol:** The liver has a remarkable capacity to regenerate after injury. Thus, even after partial removal, the hepatic mass is back to the state to what it was prior to surgery.

### Body Fluids & Circulation

- 1.Sol:** Eating foods that contain saturated fats raises the level of cholesterol in the blood. High levels of Low Density Lipoprotein cholesterol in blood increases the risk of heart disease.

- 2.Sol:** Since, 'O' blood does not have A or B antibodies on the surface of the cells they do not clump when either antiserum A or B is added.

- 3.Sol:** Rhesus (Rh) factor is an inherited protein found on the surface of red blood cells.

Problem occurs when father is Rh positive and mother is Rh negative then the second pregnancy has chances of miscarriage.

- 4.Sol:** Arteries don't require valves because pressure from the heart is so strong that blood is only able to flow in one direction. Whereas, Veins carry the blood back to the heart.

### Excretory Products & Their Elimination

- 1.Sol:** Haemodialysis is a way of cleansing the blood of toxins, extra salt and fluids through a dialysis machine. It is used when kidneys fail.

### Neural Control Coordination

- 1.Sol:** The cornea provides 65-75% of an eye's focusing power. Light enters the eye through the transparent cornea and passes through the pupil at the centre of the iris.
- 2.Sol:** The cerebrum is the largest part of the brain. It is responsible for memory, speech,

the senses, and emotional response.

- 3.Sol:** Since spinal cord is a part of nervous system, hence its injury may affect the reflex actions like sneezing.

### Chemical Coordination & Integration

- 1.Sol:** In animals, hormones are secreted by endocrine glands which are directly poured into the blood stream.

### Principles of Inheritance & Variation

- 1.Sol:** Alleles are different forms of the same gene. Some genes have a variety of different forms, which are located at the same position,
- 2.Sol:** The probability of getting a boy again is 50% similarly, probability of getting a girl is also 50%.

### Human Reproduction

- 1.Sol:** The placenta is an organ formed during embryonic development. It is a tissue formed with the help of both maternal and foetal tissues.

### Evolution

- 1.Sol:** Charles Darwin also known as the father of evolution, wrote the book "On the origin of species".
- 2.Sol:** Archaeopteryx is a Jurassic fossil bird that shares both bird and reptile features. It is considered as a connecting link between reptiles and birds.

### Human Health & Diseases

- 1.Sol:** Nearly all ulcers are caused due to a bacterium called *Helicobacter pylori*. Thus, treating *H. pylori* with antibiotics has lots of benefits.
- 2.Sol:** Leukemia is cancer of the blood. It does not usually form solid tumors.
- 3.Sol:** The use of antibiotics has long been linked to deprivation of gut bacteria. These beneficial bacteria get killed when antibiotics are administered and thus the supply of vital vitamins is obstructed.

- 4.Sol:** Pus is a whitish-yellow, yellow, or brown-yellow protein-rich fluid called liquor puris that accumulates at the site of an infection. It consists of a build-up of dead, white blood cells that form when the body's immune system responds to the infection.

- 5.Sol:** Meningitis is an inflammation or swelling of the protective membranes covering the brain and spinal cord. The most common causes of meningitis are bacterial infections.

### Strategies for Enhancement in Food Production (Animal Breeding)

- 1.Sol:** During summers it is very easy to set curd and it usually sets within 2 to 3 hours this is because bacteria multiply faster in warm temperature.

- 2.Sol:** The true grasses, family Poaceae (or, Gramineae), are the most economically important family in the monocotyledonous group. Monocot seeds include grasses, such as corn and rye, and grains such as wheat and rice.

### Biodiversity & Conservation

- 1.Sol:** In an ecosystem, all organisms have a definite role to play. Insects are important as they bring about pollination. So if a particular pollinating species is wiped off from the ecosystem, then it will affect the life of the plant also, which in due course of time may also get extinct.

### Organisms & Population

- 1.Sol:** Vegetation is generally same in same latitudes.

### Ecosystem

- 1.Sol:** In tree ecosystem the pyramid of number is intermediate. Here the number of primary consumers is more than producers as well as top consumers.

### Miscellaneous

- 1.Sol:** Plagiarism is the practice of taking someone else's work or ideas and passing them off as one's own.

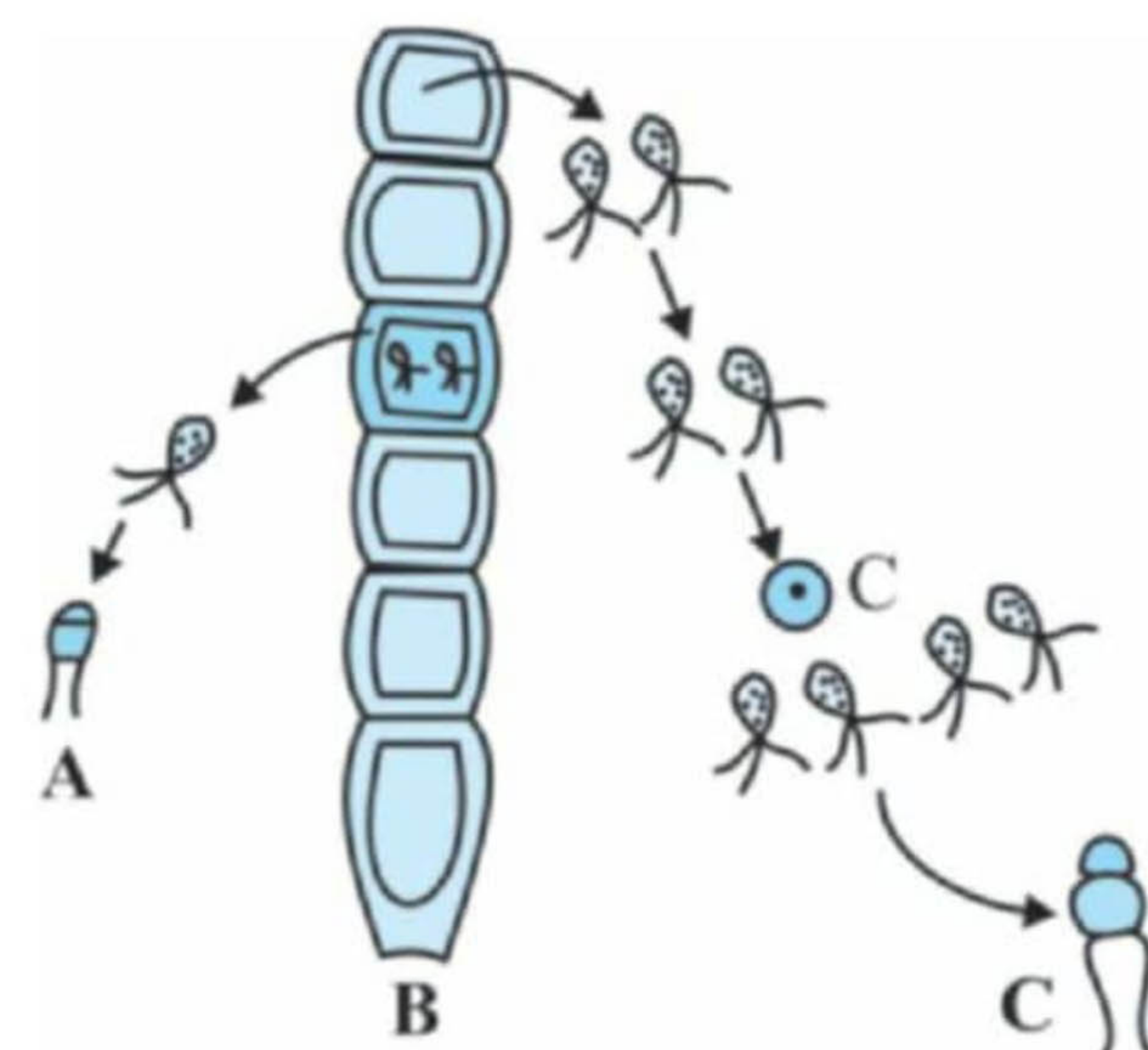


# NSE - BIOLOGY

## CLASS X

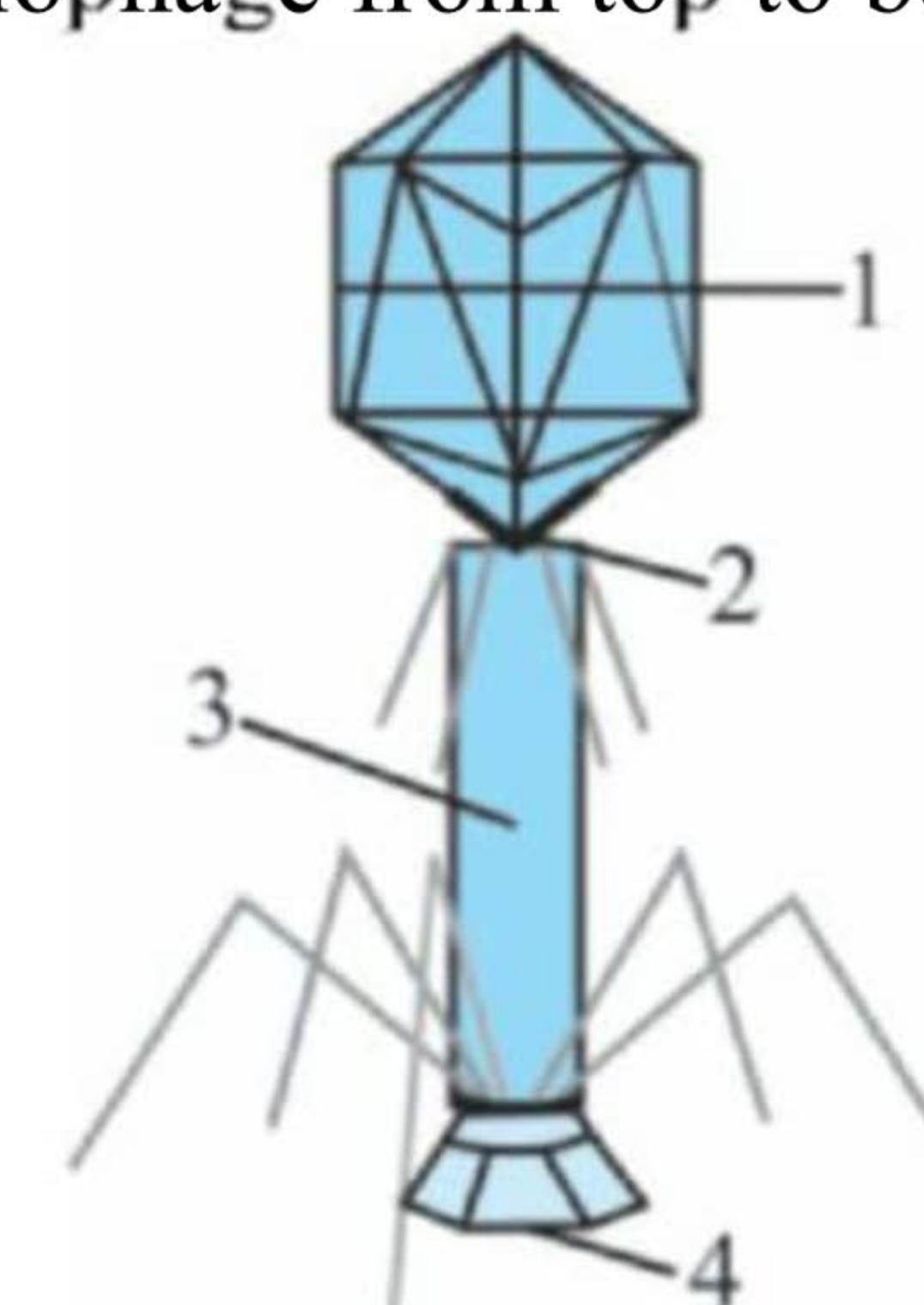


1. A strain of motile Gram positive bacterium, when treated with lysozyme, lost its pathogenicity. The virulence of the bacterium is most likely due to
  - (a) Flagellum
  - (b) Cell membrane
  - (c) Cell wall
  - (d) Pili
2. Which statement is true only for organisms belonging to the kingdom -Fungi?
  - (a) They are multicellular and photosynthetic
  - (b) They have cell walls and reproduce by seeds
  - (c) They have filamentous growth and cell walls made of chitin
  - (d) They have roots and starch is the main storage molecule
  - (e) They have numerous cellular organelles, but only one nucleus per cell
3. The characteristics of phylum-Rotifera, Nematoda and platyhelminthes are
  - (a) Bilateral symmetry, pseudocoelomate complete or sac-like digestive tract
  - (b) Bilateral symmetry, acoelomate, greatly reduced digestive tract
  - (c) Bilateral symmetry, coelomate/acoelomate, complete digestive tract
  - (d) Radial symmetry, pseudocoelomate, no digestive tract
4. Which of the following is not found in the phylum-Chordata?
  - (a) Bilateral symmetry
  - (b) An extranal skeleton
  - (c) A dorsal hollow nerve chord
  - (d) Gill slits at some stage during development
5. Life cycle of Ulothrix shown in the diagram. The correct ploidy levels at the four stages A, B, C and D are :



- (a) A-n B-n C-2n D-n
  - (b) A-n B-n C-2n D-2n
  - (c) A-2n B-n C-2n D--n
  - (d) A-n B-n C-n D-n
6. Which of the following is not in the phylum-Mollusca (molluscs)?
    - (a) Clam
    - (b) Oyster
    - (c) Shrimp
    - (d) Snail
    - (e) Squid
  7. Which of the following is true about the photosynthetic protista?
    - (a) Dinophyta often have cell wall made up of armour plates
    - (b) Bacillariophyta are commonly found as phytoplankton
    - (c) All of them have chlorophyll
    - (d) All of the above
  8. Which of the following is true of alternation of generation?
    - (a) The sporophyte undergoes syngamy to produce spores
    - (b) The sporophyte undergoes meiosis to produce spores
    - (c) The gametophyte undergoes syngamy to produce spores

- (d) The gametophyte undergoes meiosis to produce gametes
9. Air bladder is
    - (a) A respiratory organ in birds
    - (b) Excretory organ in Mammals
    - (c) A cnidarian
    - (d) A hydrostatic organ in bony fishes
  10. The principle pigment imparting distinctive brown or olive brown colouration to the thallus of phaeophyta is
    - (a) sinphonaxanthin
    - (b) fucoxanthin
    - (c) necoxanthin
    - (d) flavoxanthin
  11. Mark the correct labelling in the T4 bacteriophage from top to bottom.



- (a) Collar, head, tail, endplate, tail fibre
  - (b) Head, collar, tail, endplate, tail fibre
  - (c) Head, endplate, tail, collar, tail fibre
  - (d) Head, collar, tail, endplate, tail fibre
12. The top five crops, as on date, in terms of annual world production in millions of metric tonnes belong to the families.
    - (a) Gramineae and Solanaceae
    - (b) Gramineae and Cruciferae
    - (c) Gramineae and Leguminosae
    - (d) Leguminosae and Cucurbitaceae
  13. One of the following is not a feature of amphibians
    - (a) Habitate-damp places
    - (b) Egg - laying in water
    - (c) Scaly skin
    - (d) larvae respire by gills
  14. The numbered items corresponding with those marked with letters are
 

<b>Column I</b>	<b>Column II</b>
A. Green algae	1. Floridean starch

- B. Brown algae
  - C. Red algae
  - D. Golden brown or green algae
2. Frustules
  3. Prokaryotic
  4. Mannitol
  5. Gemma
  6. Starch

**Codes:**

A B C D	A B C D
(a) 6 4 2 5	(b) 6 3 2 4
(c) 5 4 1 2	(d) 6 4 1 2

15. Match the following structures of a sponge with their respective functions and mark your answer from the code given below

**Column I**      **Column II**

- |                   |   |
|-------------------|---|
| A. Amoebocyte     | 1. Control of water entry                 |
| B. Epidermal cell | 2. Movement of water and filter of food   |
| C. Collar cells   | 3. Skeletal support element               |
| D. Spicules       | 4. Transport of food to non feeding cells |

**Codes:**

A B C D	A B C D
(a) 1 3 4 2	(b) 3 2 1 4
(c) 4 1 2 3	(d) 2 4 3 1

16. Monotremes are unique mammals because they
  - (a) Possess hair
  - (b) give birth to live young
  - (c) secrete milk in a pouch
  - (d) lay eggs
  - (e) possess a bill
17. Which of the following is present in the respiratory system of insects, fish and mammals?
  - (a) Blood containing oxyhaemoglobin
  - (b) Alveoli
  - (c) Spiracles
  - (d) A thin moist surface
18. Which of the following correctly ranks the following structures in terms of size, from smallest to largest? Virus particle (VP), algal cell (AC), water molecule (WM), chloroplast (CH), phospholipid molecule (PM).
  - (a) WM-PM-VP-CH-AC
  - (b) VP-WM-CH-PM-AC
  - (c) WM-VP-PM-AC-CH



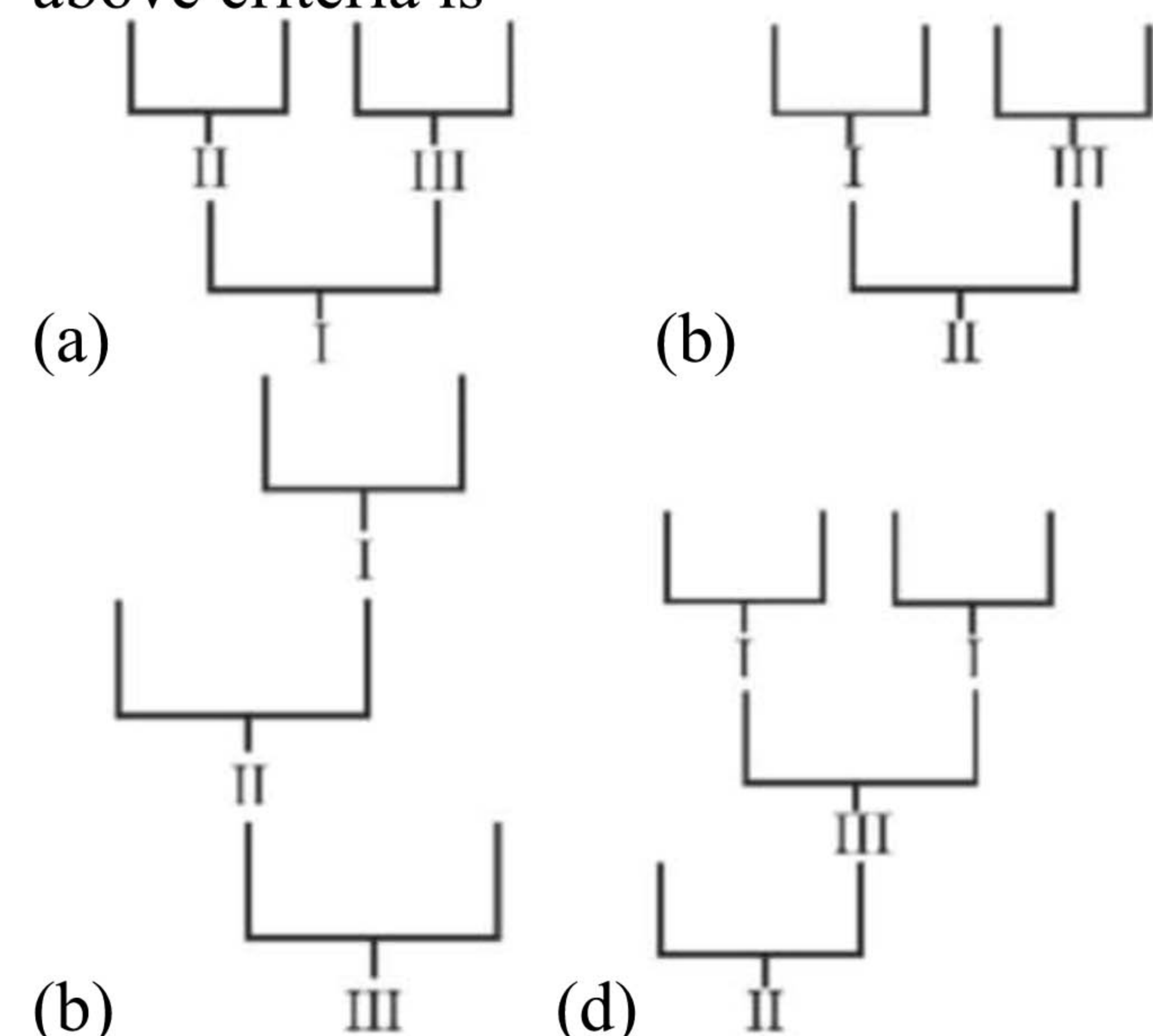
(d) PM-WM-VP-CH-AC

19. The gymnosperms differ from the ferns in that

- (a) Sexual fusion does not occur in water
- (b) They have vascular tissue
- (c) They have a large gametophyte
- (d) They produce gymnosporangia

20. Some criteria for classifying animals are

- I. Presence or absence of coelom
  - II. Presence or absence of true tissue organization.
  - III. Presence of 2 or 3 tissue layers.
- The correct way of classification using the above criteria is



21. Pick out the correct answer by using the codes given below. Mycorrhizal association is obligatory for growth in

- I. Formation of apothecia in lichens
- II. Growth of gametophytes in some species of *Lycopodium*.
- III. Growth of coralloid roots of cycas.
- IV. Germination of the seeds of Orchidaceae.

- (a) I and III
- (b) II and IV
- (c) II and III
- (d) III and II

22. Whirling whips are protists which possess two flagella that beat

- (a) Slightly towards one side so as to cause rotation of the organism while moving forward
- (b) Forward, backward and sideways depending upon the requirement
- (c) At right angle to each other due to being present in different grooves

(d) Along with numerous cilia

23. Pick up the properly matched

- (a) Arthropoda-Arachnida- Lobster
- (b) Arthropoda- Myriapoda-Scorpion
- (c) Mollusca-Cephalopoda-*Octopus*
- (d) Mollusca-Gastropoda-Squid

24. Which of the following groups contain organisms that are most closely related?

- (a) *Rhizobium*, *E.coli* and *Salmonella*
- (b) *Mangifera indica*, lizard and *Mucor*
- (c) *Amoeba*, yeast and fern
- (d) Jelly fish, cat fish and whale

25. Match the following and mark the correct answer from the codes given below.

#### Column I

(Division of algae)

- A. Cyanophyta
- B. Chlorophyta
- C. Phaeophyta
- D. Rhodophyta

#### Column II

(Reserve food materials)

- 1. Chrysolaminarin
- 2. Amylopectin
- 3. Floridean starch
- 4. Starch
- 5. Laminarin

Codes:

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 4 | 5 | 3 |
| (b) | 2 | 5 | 1 | 3 |
| (c) | 2 | 3 | 5 | 1 |
| (d) | 1 | 4 | 3 | 5 |

26. Following are given some statement about bryophytes. Mark the incorrect statement

- (a) Gametophyte is dominant generation in all bryophytes
- (b) Sporophytes are always haploid
- (c) Sporophyte is dependent on gametophyte for nutrition
- (d) Water and minerals are absorbed by the whole plant

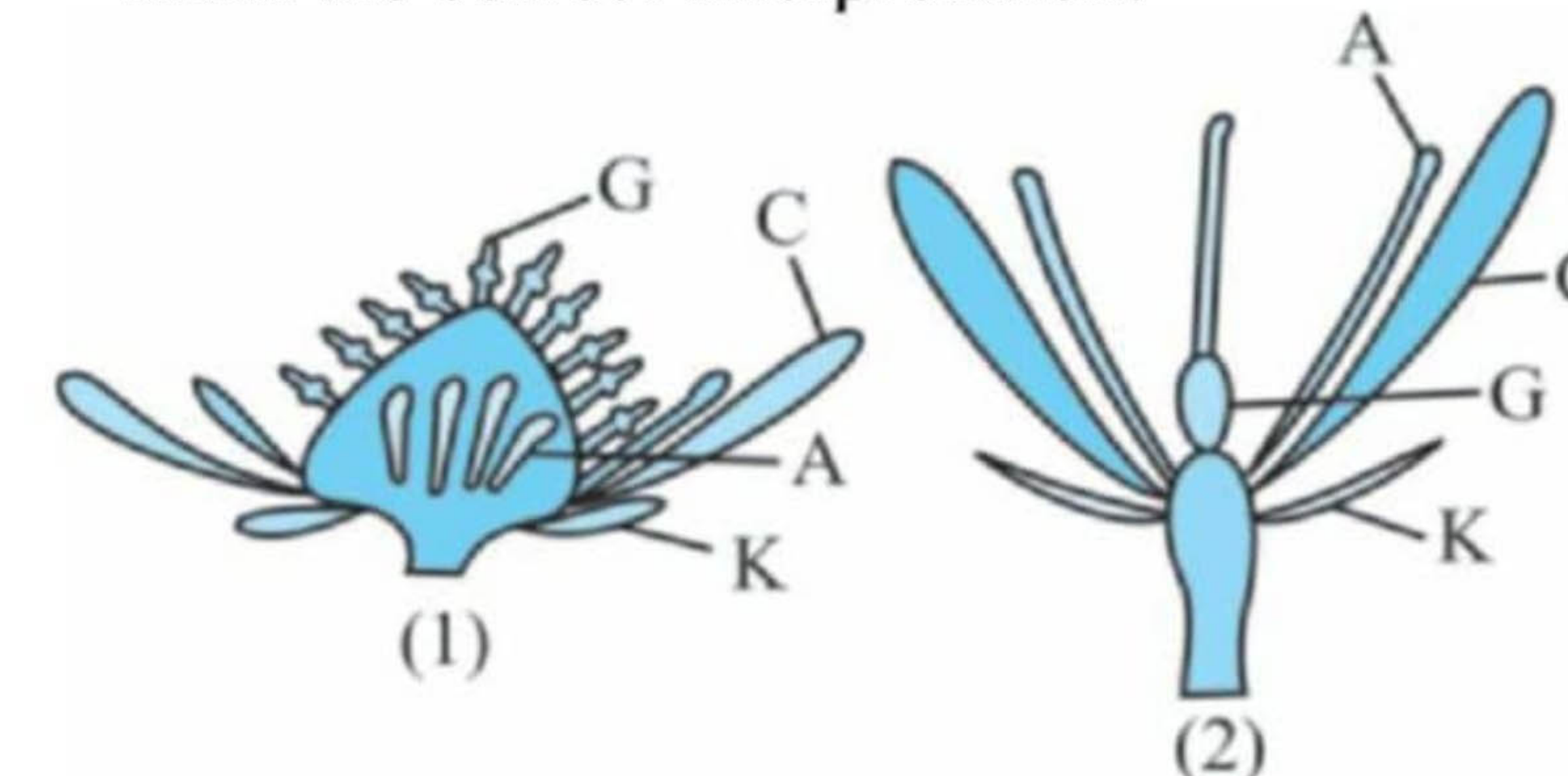
27. Placement of gymnosperms between dicotyledons and monocotyledons is one of the drawbacks in the system of classification of

- (a) Rendle
- (b) Bentham and Hooker
- (c) Engler and Prantl
- (d) Linnaeus

28. Which statement is false?

- (a) Bacteria are necessary for the decomposition
- (b) Bacteria can cause diseases of plants
- (c) Bacteria are part of your 'personal' microflora
- (d) Bacteria are necessary for biological nitrogen fixation
- (e) Bacteria are necessary for photosynthesis

29. Two flower structure are shown in the figure. mark the correct interpretation.



- (a) 1 is primitive and 2 is advanced
- (b) 1 is advanced and 2 is primitive
- (c) Both are advanced flower structures
- (d) Both are primitive flower structures

30. Which of the following is not an Indian carps?

- (a) *Catla catla*
- (b) *Labeo rohita*
- (c) *Cirrhinus mrigala*
- (d) *Cyprinus carpio*

31. Which of the following has both endoskeleton as well exoskeleton?

- (a) Cockroach
- (b) Sponge
- (c) Snake
- (d) Frog

32. Which of the following are true *Peripatus*?

- I. It is a connecting link between Annelida and Arthropoda
- II. It is a connecting link between Arthropoda and Mollusca
- III. It is living fossil.
- IV. It is endemic to South America.

- (a) I, II and III
- (b) I and III
- (c) II and III
- (d) III and IV

33. Agnatha or Cyclostomata are characterized by

- (a) Absence of jaws and presence of suctorial mouth
- (b) Presence of suctorial, mouth, absence of jaws, presence of single nostril and unpaired fins

(c) Absence of mouth, presence of single nostril

(d) Round mouth with triradiate lips

34. An archegonium of *Riccia* has

- (a) 4 neck canal cells, 1 venter canal cell and 1 oosphere
- (b) 4 neck canal cells, 2 venter canal cell and 1 oosphere
- (c) 4 neck canal cells, 1 venter canal cell and 2 oospheres
- (d) 6 neck canal cells, 2 venter canal cells and 1 oosphere

35. A plant from Liliaceae whose underground stem yields a chemical mutagen, which produces polyploids by hindering the spindle formation. Which is the plant?

- (a) *Solanum tuberosum*
- (b) *Nicotiana glauca*
- (c) *Parthenium hysterophorus*
- (d) *Colchicum autumnale*

36. Which important aspect of the classification of all organisms is attributed to Carl Linnaeus?

- (a) The use of Latin
- (b) The use of branching diagrams (trees) to depict relationships among groups
- (c) The use of standardized common names
- (d) The use of two-part names (binomials)
- (e) The use of keys for identification

37. It is generally agreed that prokaryotes constituted the first life on earth. It is also generally accepted that the early eukaryotes were

- (a) Photosynthetic
- (b) Chemosynthetic
- (c) Heterotrophs
- (d) Multicellular
- (e) Unicellular

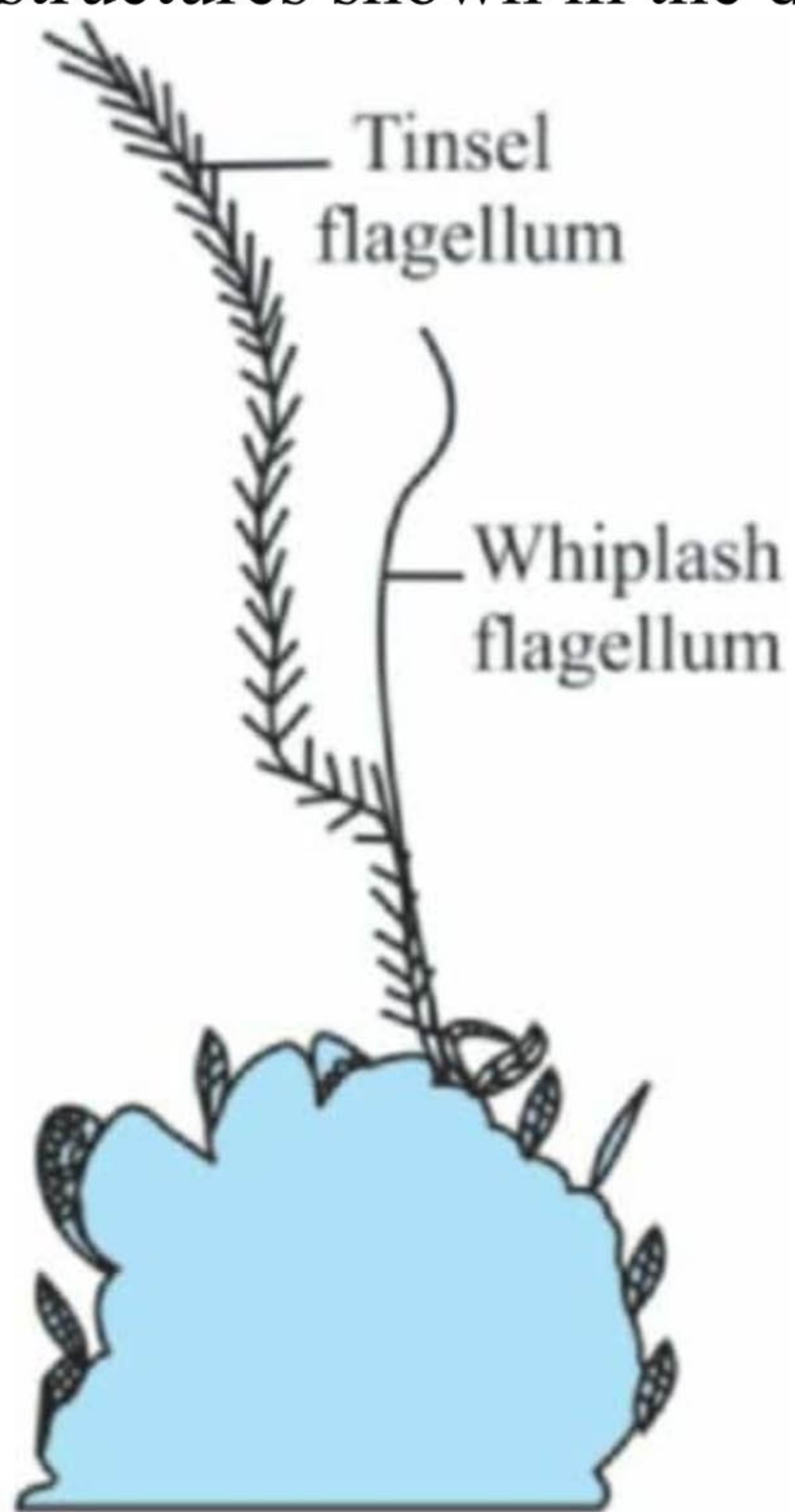
38. Which statement is false?

Bacteria are involved in

- (a) animal diseases
- (b) decomposing dead organic matter
- (c) nitrogen processing in the soil
- (d) food digestion in animals
- (e) alcohol production in beer

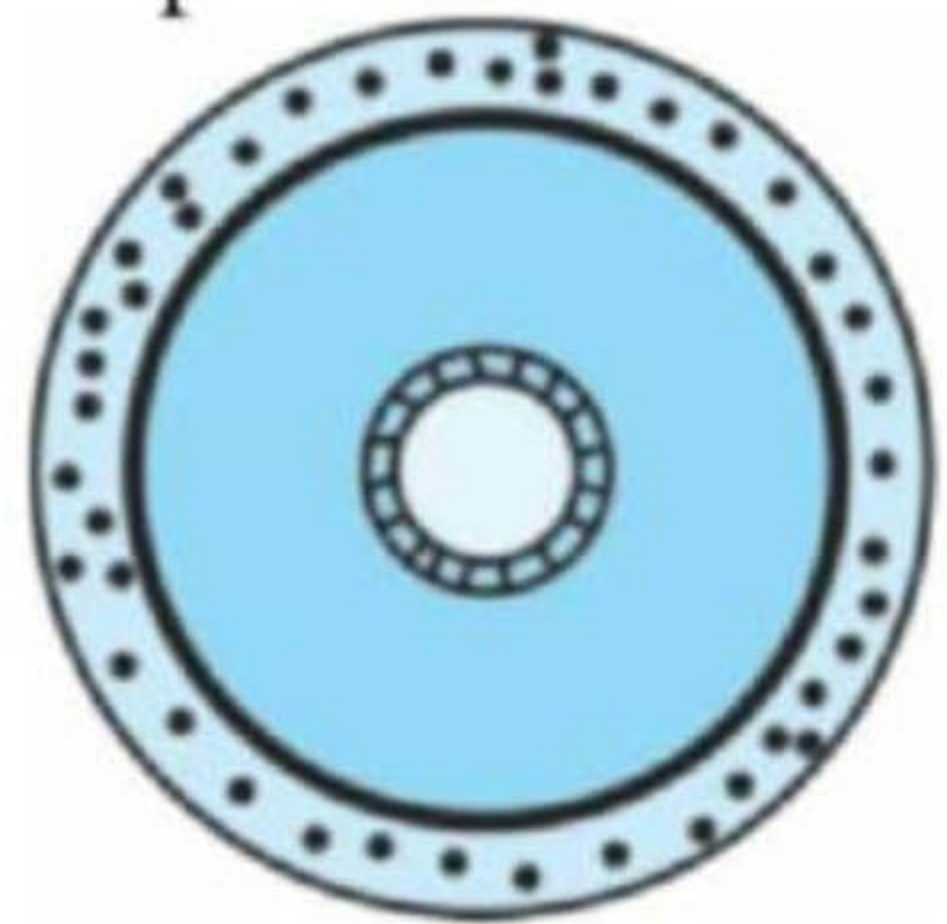


39. The endosperms of an angiosperm differ from that of a gymnosperm in that it
- (a) Is triploid
  - (b) Only lasts a few days
  - (c) Does not form until fertilization takes place
  - (d) Both (a) and (c)
40. Which of the following animals is not a mammal?
- (a) Bird
  - (b) Kangaroo
  - (c) Dog
  - (d) Human
  - (e) *Echidna*
41. Both algae and fungi are not independently capable of initiating seral change on bare rocks but lichens can do so because they
- (a) Adapt suitably to xeric conditions
  - (b) Are a combination of algae and fungi
  - (c) Can secrete acids causing weathering of rocks
  - (d) do not require much moisture for growth
42. Two different animals are classified into the same family. This means they would be classified in
- (a) The same phylum, but different class
  - (b) The same class but different species
  - (c) A different kingdom and different phylum
  - (d) A different class and a different order
  - (e) The same genus, but different phylum
43. What group(s) of organisms are characterized by the structures shown in the diagram?



- (a) Rhodophyta
  - (b) Chlorophyta
  - (c) Heterokonts
  - (d) All of the above
44. Which of the following descriptions does not apply to Phaeophyta?
- (a) Dominant photosynthetic pigment is fucoxanthin
  - (b) Stores carbohydrates as mannitol
  - (c) Nearly all are freshwater
  - (d) Body is filamentous or thalloid
45. Which of the following use their own metabolic energy to maintain a near constant body temperature?
- I. Fish
  - II. Birds
  - III. Reptiles
  - IV. Amphibians
  - V. Mammals
- (a) I, II, III, IV and V
  - (b) II, III, IV and V
  - (c) II, III and V
  - (d) II and V
  - (e) V only
46. A major difference between insect and vertebrate population is that
- (a) The insect populations are based on family unit, whereas the vertebrate society is not
  - (b) There is more recognition of individuals in vertebrate rather than insect populations
  - (c) Only insects display altruistic behaviour to benefit the society
  - (d) Communication is absent in insect populations
47. Which of the following statements about reproduction in *paramecium* are true ?
- I. Conjugation is process of sexual reproduction
  - II. Macronuclei always divide mitotically,
  - III. Conjugation is a process of only genetic recombination.
  - IV. During the process of conjugation, each paramecium gives and recives equal amount of DNA.
- (a) I, III and IV
  - (b) II and IV
  - (c) III and IV
  - (d) Both (a) and (c)
48. The Phaeophyta, Rhodophyta and Chlorophyta are distinguished by the following feature.
- (a) Their degree of multicellulararty

- (b) Their accessory (light-harvesting ) pigments
  - (c) Nuclei
  - (d) All of the above
49. The figure represent the interial body plan of



- (a) Platyhemintnes
  - (b) Nematoda
  - (c) Annelida
  - (d) Echinodermata
50. A volcano rises from the floor of the ocean. The resulting island gradually becomes populated with living organisms. The most likely order of colonization is
- (a) Blue-green algae, grass, trees, birds and snakes

ANSWER KEY

- 1. c
- 2. c
- 3. a
- 4. b
- 5. a
- 6. c
- 7. d
- 8. b
- 9. d
- 10. b
- 11. d
- 12. c
- 13. c
- 14. d
- 15. c
- 16. d
- 17. d
- 18. b
- 19. a
- 20. d
- 21. b
- 22. c
- 23. c
- 24. a
- 25. a
- 26. b
- 27. b
- 28. e
- 29. a
- 30. d
- 31. c
- 32. b
- 33. b
- 34. a
- 35. d
- 36. c
- 37. e
- 38. e
- 39. d
- 40. a
- 41. d
- 42. b
- 43. c
- 44. c
- 45. d
- 46. b
- 47. d
- 48. b
- 49. b
- 50. a

PUZZLE SOLUTION: AUGUST MONTH ISSUE

			1 C	L	O	N	I	N	G	G	E	N	E	S
	2 B		I	O	R	E	S	O	U	R	C	E	S	
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5 A	6 N	T	I	T	R	Y	P	S	I	N				
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11 T	R	A	N	S	G	E	N	E	S					
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# (NES) .....A competitive edge for cracking NEET

## NEET Edge Series

### Microbes In Human Welfare, Biotechnology And Its Principles

#### Microbes In Human Welfare

- Two microbes found to be very useful in genetic engineering are
  - Agrobacterium tumefaciens and Caenorhabditis elegans
  - Escherichia coli and Agrobacterium tumefaciens
  - Diplococcus and Streptococcus
  - Pseudomonas and Streptomyces
- Arrange the following organisms in the increasing order (least important first) of their importance for the welfare of human society
  - Methanobacterium
  - Acetobacter aceti
  - Streptomyces
  - Lactobacillus
  - ii, iv, iii, i
  - ii, iii, i, iii
  - iv, ii, iii, i
  - iii, i, iv, ii
- Tissue plasminogen activator is
  - an enzyme
  - Amino acid
  - A vitamin
  - a chemical that stimulate tissue differentiation
- Antibiotics are modified to enhance their potency. They are called -----
  - Semi synthetic antibiotic
  - Synthetic antibiotic
  - Hyper sensitive antibiotic
  - Good antibiotic
- Select incorrect statement on Antibiotics
  - Because of the discovery of antibiotics in the twentieth century, a number of dreaded diseases have become infected.
  - Antibiotics have saved millions of people
  - A broad spectrum antibiotic destroys a number of pathogens
  - Pencillin, bacitracin and cephalosporin disrupt bacterial cell wall formation
- Which of the following statements is correct?
  - Single cell protein is rich in high quality proteins but poor in fat.
  - BOD is the amount of oxygen that would be consumed if all the inorganic matter in one litre of water were oxidised by bacteria.
  - Trichoderma sp are free living fungi that are effective biocontrol agents of several pathogens.
  - Baculoviruses are pathogens that attack insects and other arthropods.
  - Bacillus thuringiensis is first used biopesticide.
  - Lactase enzyme is used in alcoholic fermentation.
  - Mycorrhiza is a symbiotic association between fungi e.g. Glomus and vascular plant.
  - ii, iii, vi, vii
  - i, iii, iv, v, vii
  - i, iv, vi
  - ii, vi
- Which of the following statements about mycorrhizae is false?
  - In ectomycorrhizae, association between the fungus and plant is less intimate than in endomycorrhizae
  - The mycorrhizal association of fungus and the plant may have had importance in the evolution of land plant
  - The mycorrhizal association is a mutualistic symbiosis
  - Fungal partner is associated with the only roots of the higher plants (like angiosperms)
  - Only advanced modern plants such as angiosperms possess mycorrhizae
  - Only iv
  - Only v
  - Only i and iii
  - Only ii and v
- Make correct pair
 

P. Citric acid	p. Aspergillus niger,
Q. Butyric acid	q. Clostridium butyricum
R. Proteases	r. Candida lipolytica,
S. Lipase	s. Aspergillus oryzae
(a) Pp, Qq, Rs, Sr	(b) Pp, Qq, Rr, Ss
(c) Pr, Qq, Rp, Sq	(d) Pq, Qr, Rs, Sp
- In STPs major part of sludge is pumped into large tanks called
  - Anaerobic sludge digesters
  - Aerobic sludge digesters
  - Biological sludge digesters
  - None of these
- | Column I         | Column I         |
|------------------|------------------|
| A. Saccharomyces | 1. Bacteria      |
| B. Trichoderma   | 2. Cyanobacteria |
| C. Lactobacillus | 3. Fungi         |
| D. Nostoc        | 4. Yeast         |

 Which of the combinations is correct?
 

A	B	C	D
(a) 4	2	1	3
(b) 3	4	1	2
(c) 1	2	3	4
(d) 4	3	1	2
- What would happen if oxygen availability to activated sludge flocs is reduced?
  - It will slow down the rate of degradation of organic matter
  - The center of flocs will become anoxic, which would cause death of bacteria and eventual breaking of flocs
  - Flocs would increase in size as anaerobic bacteria would grow around flocs
  - Protozoa would grow in large number
- Activated sludge should have the ability to settle quickly so that it can
  - Be rapidly pumped back from sedimentation tank to aeration tank
  - Absorb pathogenic bacteria present in wastewater while sinking to the bottom of the settling tank
  - Be discarded and anaerobically digested
  - Absorb colloidal organic matter
- Formation of flocs means
  - Association of virus with the bacterial remains in water
  - Bacteria which is associated with the mycorrhiza of the fungus of soil
  - Bacteria which is associated with the mycorrhiza of the fungus of water
  - Bacteria which is associated with the solid waste of the water
- Enzyme immobilization is
  - changing pH
  - Conversion of active enzyme into inactive enzyme
  - Conversion of inactive enzyme into active enzyme
  - Providing enzyme with protective covering.
- Which of the following microbial organisms can be used as biocontrol agents?
  - Lady bird beetle and NPV,
  - Dragon flies,
  - Bt and Gambusia fish,
  - Trichoderma & Bt
  - iii, iv
  - i, ii, iii, iv
  - i, iii, iv
  - iv
- Select incorrect statement regarding biocontrol agents
  - Biocontrol refers to use of chemical methods for controlling plant and pest's



- (b) Biocontrol is a holistic approach that seeks to develop an understanding of the webs of interaction between the myriad organisms
- (c) Pollution can be controlled by this approach
- (d) Trichoderma is effective biocontrol agent
17. Identify incorrectly matched pair
- (a) Free living nitrogen fixing bacteria - Azotobacter
- (b) Free living nitrogen fixing cyanobacteria - Anabaena
- (c) Symbiotic nitrogen fixing bacteria - Rhizobium
- (d) Symbiotic nitrogen fixing bacteria cyanobacteria - Beijernickia
18. Which one of the following is most active nitrogen fixer of rice fields?
- (a) Aulosira fertilissima
- (b) Aulosira godoyana
- (c) Aulosira fritschii
- (d) Aulosira implexa
19. Biofertilizers include
- (a) Blue green algae, rhizobia and other  $N_2$  fixing bacteria
- (b) Blue green algae, rhizobia and lichens
- (c) Rhizobia, other  $N_2$  fixing bacteria and mycorrhizal fungi
- (d) Blue green algae, rhizobia and mycorrhizal fungi
20. Pollution from animal excreta and organic waste from kitchen can be most profitably minimized by
- (a) Using them for producing biogas
- (b) Using them directly as biofertilizer
- (c) Using them directly as bioinsecticide
- (d) Organic farming
21. In which case, tertiary treatment is omitted
- (a) If treated water is to be passed into rivers and streams
- (b) If treated water is to be passed into drinking water channels
- (c) If treated water is used for biogas production
- (d) In all the cases

22. Fill up blanks by selecting the correct option
- i. ----- have been commercialized as blood cholesterol lowering agent
- ii. ----- used as an immunosuppressive agent in organ transplant patients
- iii. ----- is a tissue plasminogen activator
- (a) Statins, Cyclosporin A, Streptokinase
- (b) Cyclosporin A, Statins, Chymosin
- (c) Cyclosporin A, Citric acid, Butyric acid
- (d) None of these
23. Select the correct statements from the following
- (a) activated sludge - sediment in settlement tanks of sewage treatment plant is a rich source of aerobic bacteria.
- (b) Biogas to produced by the activity of bacteria on animal waste
- (c) Methanobacteria is an aerobic bacterium found in rumen of cattle
- (d) Bio-gas, commonly called gobar gas, is pure methane
24. Secondary sewage treatment is mainly a
- (a) Biological process
- (b) Physical process
- (c) Mechanical process
- (d) Chemical process
25. The most abundant prokaryotes helpful to humans in making curd from milk and in production of anti biotics are the one categorized as
- (a) Chemosynthetic autotrophs
- (b) Heterotrophic bacteria
- (c) Cyanobacteria
- (d) Archaeobacteria
26. In 1928, a scientist discovered the first effective antibiotic, scientist and antibiotic are
- (a) Flemming - streptomycin
- (b) Flemming- penicillin
- (c) Waksman - pencillin
- (d) Waksman - streptomycin
27. Which one(s) is/are correct about Cyclosporin A?
- (a) It is produced by the fungus

- Trichoderma polysporum
- (b) It is used as an immuno suppressive agent during organ transplantation
- (c) Both (a) and (b)
- (d) It is produced by a type of yeast, Monascus purpureus
28. Which of the following statement is incorrect w.r.t. pectinases?
- (a) They are used in clearing of fruit juices
- (b) They are used in chill proofing beer and whisky
- (c) They are obtained from by *Saccharomyces flavous*
- (d) They are used in retting of fibres
29. Read the following four statements (A-4) about certain mistakes in two of them :
- i. Dough, which is used for making foods such as dosa and idlii is fermented by fungi and algae
- ii. Toddy, a traditional drink of southern India is made by fermenting sap from palms
- iii. Large holes in Swiss cheese are dueto production of large amount of methane by *Propioni bacterium sharmanii*
- iv. In our stomach, lactic acid bacteria play very benficial role in checking disease-causing microbes
- Which are the two statements having mistakes?
- (a) Statements (i) & (iii)
- (b) Statements (i) & (ii)
- (c) Statements (ii) & (iii)
- (d) Statements (iii) & (iv)
30. Consider the following four statements (a-d) and select the option which includes all the correct ones only,
- i. Single cell Spirulina can produce large quantities of food rich in protein, minerals, vitamins etc.
- ii. Body weight-wise the microorganism *Methylophilus methylotrophus* may be able to produce several times more proteins than the cows per day
- iii. Common button mushrooms are a very rich source of vitamin C

- iv. A rice variety has been developed which is very rich in calcium.
- Options :
- (a) Statements (iii), (iv)
- (b) Statements (i), (iii) and (iv)
- (c) Statements (i), (ii)
- (d) Statements (ii), (iii) and (iv)
31. Secondary treatment of sewage
- (a) Removes grit and large pieces of organic matter
- (b) Involves shredding, churning, filtration and sedimentation
- (c) Does not require aeration
- (d) Involves microbial digestion of organic matter
32. Select incorrect w.r.t sewage treatment plants.
- (a) in anaerobic sludge digester, gases like methane,  $H_2$  and  $CO_2$  are also produced.
- (b) Bacterial flocs are allowed to sediment in setting tank when BOD of sewage is high.
- (c) Primary treatment of sludge is based on sequential filtration and sedimentation.
- (d) Activated sludge is pumped into anaerobic sludge digesters to digest the bacteria and fungi
33. Besides dung, the weed which can be used in biogas production is
- (a) *Hydrilla*
- (b) *Solanum nigrum*
- (c) *Eichhornia crassipes*
- (d) *Parthenium hysterophorus*
34. Glomus is a
- (a) Cyanobacterium
- (b) Symbiotic nitrogen fixing bacterium
- (c) Endomycorrhizal fungus
- (d) Non symbiotic nitrogen fixing bacterium
35. Benefits of mycorrhizae are
- i. Resistance to root-borne pathogens
- ii. Tolerance to salinity and absorption of phosphorus
- iii. Tolerance to drought
- iv. Overall increase in the plant growth and development
- (a) only i and ii                      (b) only ii and iii



- (c) only iii and iv (d) i, ii, iii and iv

36. Farmers have reported over 50% higher yields of rice by using the biofertilizer :

- (a) Mycorrhiza  
(b) Azolla pinnata  
(c) Cyanobacteria  
(d) Legume-Rhizobium symbiosis

37. Which microorganism is useful to obtain short chain fatty acids?

- (a) *Saccharomyces cerevisiae*  
(b) *Azotobacter aceti*  
(c) *Clostridium butyricum*  
(d) *Aspergillus niger*

38. Study the following table

- |                                      |           |             |
|--------------------------------------|-----------|-------------|
| i. <i>Aspergillus niger</i>          | A fungus  | Citric acid |
| ii. <i>Saccharomyces cerevisiae</i>  | Algae     | Ethanol     |
| iii. <i>Lactobacillus delbruchii</i> | Bacterium | Penicillin  |
| iv. <i>Streptococcus sps</i>         | Bacterium | Clot buster |

The correct combination is

- (a) i & ii (b) i & iv  
(c) i & iii (d) iii & iv

39. Match the Column I with Column II-

- | Column I   | Column II   |
|--|---|
| A. The stage in which physical treatment of sewage is done     | 1. Anaerobic digestion of activated sludge and production of biogas |
| B. The stage in which biological treatment of sewage is done.  | 2. Activated sludge   |
| C. The names of sediment and supernatant in primary treatment. | 3. Aeration tanks   |
| D. ----- is carried to aeration tanks from primary settling    | 4. Primary effluent   |
| E. Site of flocs growth, effluent                              | 5. Primary sludge,  |
| F. Name of the sediment of                                     | 6. Secondary treatment  |

secondary settling.

G. The function of Sludge digester.

- (a) A - 1, B - 3, C - 5, D - 7, E - 2, F - 4, G - 6  
(b) A - 7, B - 6, C - 5, D - 4, E - 3, F - 2, G - 1  
(c) A - 1, B - 2, C - 3, D - 4, E - 5, F - 6, G - 7  
(d) A - 7, B - 6, C - 1, D - 2, E - 3, F - 4, G - 5

### Biotechnology And Its Principles

1. Normally, the gene encoding resistance to antibiotics are considered useful selectable marker for *E. coli*

- (a) Because the normal *E. coli* cells do not carry resistance against any of these antibiotics  
(b) As it makes *E. coli* identifiable because of insertional inactivation  
(c) Because it makes *E. coli* identification through chromogenic reaction  
(d) Both (a) and (b)

2. Due to ampicillin resistance gene, one is able to select a transformed cell in the presence of ampicillin. The ampicillin resistance gene in this case is called

- (a) Selectable marker  
(b) Recombinant gene  
(c) Recognition site  
(d) Origin of replication

3. If a protein encoding gene is expressed in a heterologous host it is called

- (a) Primary protein  
(b) Recombinant protein  
(c) Tertiary protein  
(d) Secondary protein

4. Which of the following are the parts of biotechnology?

- i. Synthesis of gene  
ii. Developing a DNA vaccine  
iii. Correcting a defective gene  
iv. In vitro fertilization

- (a) i, ii, iii and iv (b) i and ii  
(c) iii and iv (d) ii and iv

5. Select the wrong statement.

- (a) DNA is a negatively charged molecule  
(b) The presence of chromogenic substrate

gives blue colour colonies, if the plasmid in the bacteria does not have an insert.

- (c) Since DNA is a hydrophilic molecule it cannot pass through cell membranes.  
(d) In microinjection, cells are bombarded with high velocity microparticles of gold or tungsten coated with DNA.

6. Which is true about biotechnology techniques?

- (a) PCR is used to cut DNA molecules  
(b) A DNA probe consists of radioactive single strand of DNA  
(c) Restriction enzymes were first discovered in Bacteriophages  
(d) Pvu I is a name for a DNA probe

7. If we ligate a foreign DNA at the BamHI site in pBR322, the recombinant plasmid will:-

- (a) Show ampicillin resistance only.  
(b) Show tetracycline resistance.  
(c) Grow well on tetracycline containing medium.  
(d) Not grow on ampicillin containing medium

8. i. In elution the separated bands of DNA are cut out from agarose gel and extracted from the gel piece.

ii. *E. coli* cloning vector pBR322 shows several restriction, Ori, antibiotic resistance genes and Rop.

iii. The down stream processing and quality control testing vary from produced to product.

iv. Competent bacterial cell cannot take up the plasmid.

- (a) All are incorrect  
(b) All are correct  
(c) Only iv is correct  
(d) Except iv all are correct

9. Consider the given statements w.r.t. gel electrophoresis.

- i. DNA can be separated by forcing them to move towards cathode under an electric field.  
ii. DNA fragments separate according to

their size through sieving effect provided by agarose gel.

iii. The used matrix in this technique is agarose which is an artificial polymer. Which of the following statements is/ are correct?

- (a) ii only (b) i and ii  
(c) i, ii, and iii (d) ii and iii

10. How many fragments of DNA is obtained when a plasmid has 6 recognition sites for a restriction endonuclease and undergo digestion with the enzymes

- (a) 4 (b) 3 (c) 6 (d) 7

11. What happens, when DNA fragments is inserted into plasmid (pBR-322) using enzyme Pvu-I or Pst-I ?

- i. Inactivation of amp<sup>R</sup> gene  
ii. Inactivation of tet<sup>R</sup> gene  
iii. Unable to grow in the presence of ampicillin  
iv. Unable to grow in the presence of tetracycline

v. Unable to replicate

Mark the correct choice :-

- (a) ii and iv are correct  
(b) i and iii are correct  
(c) i, iii and v are correct  
(d) ii, iv and v are correct

12. Which is incorrect?

- (a) EcoRI cuts the DNA between bases G and A.  
(b) Each restriction endonuclease recognizes a specific palindromic nucleotide sequences in DNA.  
(c) When cut by same restriction enzyme, the resultant DNA fragments do not have the same kind of 'sticky-ends'.  
(d) Making multiple identical copies of any template DNA is called cloning.

13. In PCR, short primers are added to single-stranded DNA molecules in a test tube and the appropriate enzymes are included to make a copy of the DNA. Which of the following primers is needed for copying the single-stranded DNA sequence



5' TACGGTAGGTC3'?

- (a) 5'GACCT (b) 5'ATGCC  
(c) 5'GGCAT (d) 5'TACGG

14. Identify the true statements -

- When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of sticky ends and these can be joined together using DNA ligase
  - The first recombinant DNA was constructed by using a piece of DNA from a plasmid carrying antibiotic resistance gene in the bacterium *Salmonella typhimurium* and linked it to the plasmid of *E. coli*.
  - Cohen and Boyer are known as father of genetic engineering.
  - Presence of more than one recognition sites within the vector will generate several fragments, which will complicate the gene cloning.
  - Endonucleases remove nucleotides from the ends of the DNA whereas exonucleases make cuts at specific positions within the DNA.
  - YAC vectors contain the telomeric sequence, the centromere and autonomously replicating sequence from yeast chromosomes.
  - Humulin was the first recombinant DNA, based product, produced and marketed in India.
  - Alkaline phosphatase, is used to- prevent unwanted self ligation of the vector DNA molecules in procedures of rDNA technology.
  - pBR322 vector was the first artificial ideal vector constructed by Boliver and Rodriguez.
  - Plasmid DNA is coated with histone proteins and can act as genetic factor.
- (a) ii, iv, vi, x (b) ii, iv, v, x  
(c) i, ii, iv, vii, vii, ix (d) i, ii, iv, vi, x

15. Which of the following statement is not true.

- (a) Hind - II always cut DNA molecules at a particular point by recognizing a specific

sequence of 4 base pairs.

- (b) Besides Hind - II, today we know more than 900 restriction, enzymes.  
(c) The name Eco RI comes from *Escherichia coli* - 13.  
(d) Type - II restriction endonuclease is most useful in genetic engineering

16. Which statement is incorrect?

- Genetic engineering is also called recombinant DNA technology
  - Bacteriophage is not used as vector
  - MALAYALAM is a palindrome
  - Ethidium bromide can not be used for staining DNA
- (a) ii, iv (b) i, ii (c) i,ii,iii,iv (d) iii, iv

17. A mixture containing DNA fragments A,B,C, and D with molecular weights,  $A+B=C$ ,  $A>B$  and  $D>C$ , was subjected to agarose gel electrophoresis. The position of these fragments from anode to cathode sides of gel should be:

- (a) A, B, C, D (b) B, A, C, D  
(c) B, A, D, C (d) C, D, A, D

18. Read the following statements carefully and select the correct option :-

- Source of the restriction enzyme Hind III is *Haemophilus influenzae*
- In biolistic method of gene transfer, microparticles made up of gold or tungsten are coated with foreign DNA
- Micro-injection method for injecting recombinant DNA is used for animal cell.
- Primers are chemically synthesized Oligonucleotides that are complementary to the regions of DNA in PCR

How many of the above statements are correct ?

- (a) Four (b) Three (c) Two (d) One

19. Choose correct statement

- Presence of more than one recognition site for one enzyme within vector generate several fragments, which will complicate gene cloning
- Ligation of alien DNA is carried out at a restriction site present in Ori

- In pBR322 one antibiotic resistance gene helps in selecting the transformants, whereas the other helps in cloning
- Rop codes for proteins involved in ligation of foreign DNA

20. Consider the following statements

- Pure DNA fragments in agarose gel can be seen by naked eyes in UV light & without staining
- DNA is a hydrophilic molecule
- Separated DNA fragments are visualized after staining the DNA with ethanol and using UV light
- Presence of more than one same recognition sites within vector will generate several fragments of vector, which will complicate gene cloning

Which of the following statement are correct?

- (a) i, ii & iii (b) ii, iii & iv  
(c) ii & iv (d) i, ii, & iv

21. Molecular probes used for identification of recombinant clone carrying the desired DNA insert can be

- Denatured double stranded DNA probes.
  - double stranded RNA probes.
  - Protein Probes.
  - Single stranded DNA probes
- (a) ii, iii (b) i, iv  
(c) i, ii (d) All of these

22. A research fellow performs following steps in a Southern blot experiment to determine the number of copies of a particular gene that has been inserted in a genetically modified organism.

- Transfer of DNA to nitrocellulose membrane.
- Create radioactive probe.
- Incubate probe and membrane
- Restriction digestion of genomic DNA.
- Cleaved DNA separated using gel electrophoresis.

Which is the correct sequence to the above steps?

- (a) ii→iii→i→iv→v (b) ii→iii→i→v→iv  
(c) iv→v→i→ii→iii (d) v→iv→iii→ii→i

23. Read the following four statements (i-iv) and select the incorrect ones.

- Downstream processing is one of the steps of rDNA technology.
- Disarmed pathogen vectors are also used in transfer of rDNA into the host.
- The first transgenic buffalo, Rosie produced milk which was human alpha-lactalbumin enriched.
- Restriction enzymes are used in isolation of DNA from other macromolecules.

Which of the two statements have mistakes?

- (a) ii and iii (b) iii and iv  
(c) i and iii (d) i and ii

24. Selection of recombinants due to inactivation of antibiotics is a cumbersome procedure because

- It requires plating of one plate having certain antibiotics
- It requires plating of two plates having same antibiotics
- It requires simultaneous plating on two plates having different antibiotics
- None of these

25. What is true about the first case of constructing a recombinant DNA—

- It was performed in 1979
- It was performed by Stanley Cohen and Herbert Boyer
- It was a transfer of an antibiotic resistant gene
- Gene was transferred from *Salmonella typhimurium* into *E. coli*
- Gene could not replicate successfully in the target bacterium

- (a) i and v (b) i, ii and iii  
(c) ii, iii and iv (d) iii, iv and v

26. Read the following statements regarding DNA polymerase used in PCR :-

- It is isolated from thermosensitive bacteria
  - It remains active at high temperature
  - It is used to ligate introduced DNA in recipient cells.
  - It serves as a selectable marker
- How many statements are correct ?



- (a) One (b) Two (c) Three (d) Four
27. Which of the following statement is correct in the context of observing DNA fragments separated by agarose gel electrophoresis?
- (a) Ethidium bromide stained DNA can be seen under exposure to UV light  
 (b) DNA can be seen in visible light  
 (c) DNA can be seen without staining in visible light  
 (d) Ethidium bromide stained DNA can be seen in visible light
28. Eukaryotic genes may not function properly when cloned into bacteria because of
- (a) Destruction by native endonucleases.  
 (b) Inability to excise introns.  
 (c) Failure of promoter to be recognized by bacterial RNA polymerase.  
 (d) All of the above.
29. While preparing for gel electrophoresis, percentage of Agarose increased from 10-20%. This would result in
- (a) Increased pore size  
 (b) DNA fragment move fast  
 (c) Decrease in pore size  
 (d) Both (a) & (b)

## ANSWER KEY

## Microbes In Human Welfare

- |       |       |       |       |       |
|-------|-------|-------|-------|-------|
| 1. b  | 2. a  | 3. a  | 4. a  | 5. a  |
| 6. b  | 7. b  | 8. a  | 9. a  | 10. d |
| 11. b | 12. a | 13. d | 14. d | 15. d |
| 16. a | 17. d | 18. a | 19. a | 20. a |
| 21. a | 22. a | 23. a | 24. a | 25. b |
| 26. b | 27. c | 28. b | 29. a | 30. c |
| 31. d | 32. b | 33. c | 34. c | 35. d |
| 36. c | 37. c | 38. b | 39. b |       |

## Biotechnology And Its Principles

- |       |       |       |       |       |
|-------|-------|-------|-------|-------|
| 1. b  | 2. a  | 3. b  | 4. a  | 5. d  |
| 6. b  | 7. a  | 8. d  | 9. a  | 10. c |
| 11. b | 12. c | 13. a | 14. c | 15. a |
| 16. a | 17. b | 18. a | 19. a | 20. c |
| 21. b | 22. c | 23. b | 24. c | 25. c |
| 26. b | 27. a | 28. b | 29. c |       |

## HINTS &amp; SOLUTIONS

## Microbes In Human Welfare

1. (b) Two microbes found to be very useful in genetic engineering are *Escherichia coli* and *Agrobacterium tumefaciens*
2. (a) *Acetobacter aceti*, *Lactobacillus*, *Streptomyces*, *Methanobacterium* are arranged based on least importance.
3. (a) Tissue plasminogen activator is a serine protease found on endothelial cells involved in the break down of blood clots.
4. (a) Antibiotics are modified to enhance their potency. They are called Semi synthetic antibiotic.
5. (a) Because of the discovery of antibiotics in the twentieth century, a number of dreaded diseases have become eradicated.
6. (b)
7. (b)
8. (a) Citric acid - *Aspergillus niger*, Butyric acid - *Clostridium butyricum* Proteases- *Aspergillus oryzae*, Lipases - *Candida lipolytica*.
9. (a) In sewage treatment plant, major part of sludge is pumped into large tanks called Anaerobic sludge digesters.
10. (d)
11. (b) The center of flocs will become anoxic, which would cause death of bacteria and eventually breakage of flocs.
12. (a) Activated sludge should have the ability to settle quickly so that it can be rapidly pumped back from sedimentation tank to aeration tank.
13. (d) Formation of flocs means bacteria associated with the solid waste of the water.
14. (d) To restrict enzyme mobility in a fixed space. The immobilized enzyme is attached to an inert
15. (d) *Trichoderma* & *Bacillus thuringiensis* is used as biocontrol agents.
16. (a) Biocontrol refers to use of biological

methods for controlling plant diseases and pests.

17. (d) *Beijerinckia* is a phyllosphere or rhizosphere nitrogen fixing bacteria.
18. (a) *Aulosira fertilissima* is most active nitrogen fixer of rice fields.
19. (a) Blue green algae, rhizobia and other  $N_2$  fixing bacteria are used as biofertilizers.
20. (a) Pollution from animal excreta and organic waste from kitchen can be most profitably minimized by using them for producing biogas.
21. (a) Tertiary treatment is omitted if treated water is to be passed into rivers and streams.
22. (a) i. Statins, ii. Cylosporine A, iii. Sterptokinase
- |         |         |
|---------|---------|
| 23. (a) | 24. (a) |
| 25. (b) | 26. (b) |
| 27. (c) | 28. (b) |
| 29. (a) | 30. (c) |
| 31. (d) | 32. (b) |
| 33. (c) | 34. (c) |
| 35. (d) | 36. (c) |
| 37. (c) | 38. (b) |
| 39. (b) |         |

## Biotechnology And Its Principles

1. (b)
2. (a)
3. (b)
4. (a)
5. (d)
6. (b) PCR is used in amplification of DNA. Restriction enzyme was first discovered in *E. coli* bacteria. Pvu I is a site on plasmid pBR322.
7. (a) Plasmid is an extra chromosomal circular, self replicating, double stranded DNA, found generally in bacteria. Presence of plasmid gives certain traits to the host, one such trait is resistance to certain toxins and antibiotics. pBR322 is the first artificial cloning vector. It has 2 antibiotic resistance genes, Tetracycline (tet R) and ampicillin

(ampR). When BamHI is used, DNA insert or ligated DNA will be placed within tet R gene making it non functional. Hence when foreign DNA is ligated BamHI in pBR322, recombinant plasmid will show resistance to ampicillin only.

8. (d)
9. (a)
10. (c)
11. (b)
12. (c) When same restriction enzyme is used, resultant DNA fragments will have same kind sticky ends since they identify the same sequence.
13. (a)
14. (c) Father of genetic engineering is Paul Berg. Endonuclease will make cuts at specific regions within DNA. Exonuclease will remove nucleotides from ends of DNA.
15. (a) Hind II is the first identified restriction endonuclease Hind II will cut DNA molecule at particular point by recognizing specific sequence of six base pairs.
16. (a)
17. (b)
18. (a) All the statements are correct.
19. (a)
20. (c)
21. (b)
22. (c)
23. (b) First transgenic cow was named Rosie. Restriction enzymes are used to break DNA molecule.
24. (c)
25. (c)
26. (b) DNA Polymerase used in PCR is Taq DNA Polymerase. It is extracted from thermophilic bacterium *Thermus aquaticus*. Optimum Temperature for its functioning is 72° C. Taq DNA Polymerase will synthesize DNA between the primers in the process of PCR.
27. (a)
28. (b)
29. (c)





## NSEJS (Stage-1)

(2009-2010)

- The animal body is formed of many cells, but the cells show no coordination to form tissues in
  - protozoans
  - coelenterates
  - sponges
  - flat worms
- An indicator of pollution is
  - moss
  - lichens
  - algae
  - pteridophytes
- The one that CANNOT be used for DNA fingerprints is
  - leucocytes
  - erythrocytes
  - hair bulbs
  - sperms
- "Green fuel" means
  - fuel obtained from plant leaves
  - green coloured fuel
  - chemicals used for the growth of plants
  - fuel obtained from plastic waste
- Which one of the following is a true fruit?
  - Pear
  - Coconut
  - Apple
  - Cashewnut
- The number of chromosomes can be counted at :
  - anaphase
  - interphase
  - metaphase
  - prophase
- Which one of the following is true fish?
  - Star fish
  - Gold fish
  - Silver fish
  - Hag fish

- The part of the digestive system that digests lipids in the food is :
  - stomach
  - duodenum
  - ilium
  - large intestine
- During contraction of muscle fiber :
  - I bands get reduced in length
  - A bands retain the length
  - I bands retain the length
  - A bands get reduced in length
- What is true about white muscles?
  - Number of mitochondria is few.
  - They possess very small quantity of myoglobin.
  - The amount of sarcoplasmic reticulum is high
  - They depend on anaerobic process of energy.
- In bacterial photosynthesis, usually :
  - $\text{CO}_2$  is not fixed
  - $\text{O}_2$  is not released
  - $\text{H}_2\text{O}$  is oxidized
  - Chlorophyll taps light

(2010-2011)

- Bacteria cannot survive in a highly salted pickle because
  - they become plasmolysed and consequently die
  - they do anaerobic respiration
  - water is not available to them
  - of all the reasons mentioned above

- Cycas is classified as gymnosperm because of
  - presence of naked seeds
  - lack of vessels in the xylem
  - presence of sieve tubes
  - fruit formation
 The correct reason is
  - (i) and (iv)
  - (i) and (iii)
  - (i) and (ii)
  - (ii) and (iii)
- Which one of the following is NOT poisonous?
  - spider
  - platypus
  - millipede
  - centipede
- The correct order of evolutionary advancement among the plants is
  - spirogyra  $\rightarrow$  diatom hornwort  $\rightarrow$  fern
  - blue green alga  $\rightarrow$  liverwort  $\rightarrow$  fern seed  $\rightarrow$  bearing plant
  - liverwort  $\rightarrow$  cyanobacterium  $\rightarrow$  moss  $\rightarrow$  gymnosperm
  - red alga  $\rightarrow$  fern  $\rightarrow$  moss  $\rightarrow$  liverwort
- Lamina of a plam tree is dissected so as to adapt to
  - intense light
  - high wind velocity
  - scarcity of moisture
  - high temperature
- Which of the following pigments is different from others?
  - cyanoglobin
  - myoglobin
  - haemoglobin
  - cytochrome
- The feature indicating omnivorous nature of man is
  - presence of canines and molar
  - long intestine and vestigal appendix
  - ability to taste salty and sweet material
  - spacious stomach and caecum
- Considering the root system, the plant that has adapted to the arid conditions is
  - hydrilla
  - sunflower
  - hibisucs
  - khus
- The random motion of visible particles caused by the much smaller invisible particles of water is an example of
  - Brown motion
  - Brownian motion

- Brownmat motion (d) Browniz's motion
- When a cell fails to communicate with other cells in multicellular organism, it
  - becomes cancerous
  - enters mitotic phase
  - chooses to die
  - is eaten up by other cells
- A desert room cooler cools better on hot and dry day due to
  - increase in the rate of evaporation
  - decrease in the rate of evaporation
  - decrease in the rate of vapourization
  - increase in the rate of diffuison
- The body of hydra is cut transversely into three pieces and the middle piece is kept upside down on the substratum. Then,
  - it fails to regenerate into an independent hydra
  - it would form tentacles and foot in the same locations as oriented
  - it would form tentacles and foot at the original upper and lower ends
  - it will form a hydra with tentacles at both the ends
- Maximum vitamin A content is likely to be found in the extract of
  - sprout of a pulse
  - cod liver
  - white muscles
  - rose petals
- Complete digestive juice having enzymes to digest all types of organic materials is secreted by
  - salivary gland and pancreatic gland
  - gastric gland and pancreatic gland
  - salivary gland and intestinal gland
  - pancreatic gland and intestinal gland
- The animal in which coelomic fluid has a significant role in locomotion is
  - earthworm
  - leech
  - crab
  - sea cucumber
- The tissue whose activity is important in vegetative propagation of a plant by grafting is
  - meristem
  - phloem
  - cambium
  - pith



17. An animal with chitinous exoskeleton, haemocoel and gills belongs to  
(a) aschelminthes (b) Arthropoda  
(c) Echinodermata (d) Urochordate
18. The ointment prescribed for burns usually contains, among other ingredients,  
(a) vitamin A (b) vitamin B  
(c) vitamin D (d) vitamin E
19. A child having protruding belly, bulging eyes, thin and curved legs and peeling skin is likely to be suffering from  
(a) kwashiorkor (b) rickets  
(c) marasmus (d) xerophthalmia

## ANSWER KEY

(2009-2010)

1. c 2. b 3. b 4. a 5. b  
6. c 7. b 8. b 9. a, b  
10. a, b, c, d 11. b, d

(2010-2011)

1. a 2. c 3. c 4. b 5. b  
6. a 7. a 8. d 9. b 10. c  
11. a 12. c 13. b 14. d 15. a  
16. c 17. b 18. d 19. a

## HINTS &amp; SOLUTIONS

(2009-2010)

- 1.Sol: Sponges have cellular-level organization, meaning that their cells are specialized so that different cells perform different functions, but similar cells are not organized into tissues and bodies are a sort of loose aggregation of different kinds of cells.
- 2.Sol: Lichens are well known as sensitive indicators of air pollution, particularly for sulphur dioxide.
- 3.Sol: Although blood is an excellent source of DNA, the DNA does not come from the red blood cells, as these cells have no nuclei. Rather, the DNA comes chiefly from white blood cells in the blood.

4.Sol: Green fuel, also known as biofuel, is a type of fuel distilled from plants and is more environment friendly.

5.Sol: A true fruit or eucarp is a mature or ripened ovary, developed after fertilization. Here coconut is a true fruit whereas, rest are false fruits.

6.Sol: Metaphase in cells are characterized by the arrangement of chromosomes at the equatorial plane of the cell

7.Sol: Gold fish is a true fish. Starfish is an echinoderm, silver fish is an insect and hagfish is a cyclostome.

8.Sol: The small intestine is the major site for lipid digestion. There are specific enzymes for the digestion of triglycerides, phospholipids, and cleavage of esters from cholesterol.

9.Sol: When a sarcomere contracts, the Z lines move closer together, and the I band becomes smaller however, the A band remains constant.

10.Sol: These muscle fibres are lighter in colour as they do not have myoglobin. Mitochondria are less in number. White muscles have more sarcoplasmic reticulum. They depend mainly on anaerobic oxidation (glycolysis) for energy production and accumulate lactic acid in considerable amounts during strenuous work and soon get fatigued.

11.Sol: The photosynthetic bacteria are oxygenic as they do not evolve  $O_2$  during photosynthesis and have comparatively simple photo transduction machinery with only one type of photosystem and reaction centre. The bacterial chlorophyll traps light like normal chlorophyll.

(2010-2011)

1.Sol: Salting is used because most bacteria, fungi and other potentially pathogenic organisms cannot survive in a highly salty environment, due to the hypertonic nature of salt. Any living cell in such an environment will become dehydrated through osmosis and die.

2.Sol: Gymnosperms are seed-bearing vascular plants, in which the ovules or seeds are not enclosed in an ovary.

3.Sol: Millipedes are not poisonous, but many species have glands capable of producing irritating fluids that may cause allergic reactions in some individuals.

4.Sol: The evolution of plants occurred in the following sequence- blue green alga → liverwort → fern seed → bearing plant.

5.Sol: The dissected lamina in palms is an adaptation to high wind velocity.

6.Sol: Cyanoglobin is a hemeprotein, found in certain cyanobacteria whereas, myoglobin is an iron- and oxygen-binding protein found in the muscle tissue of vertebrates and haemoglobin is a red protein responsible for transporting oxygen in the blood of vertebrates. Cytochromes occur in all organisms except a few obligate anaerobes.

7.Sol: Presence of incisors, canines, molars and premolars are substantial evidence to say that humans are omnivores.

8.Sol: The root system of Khus is finely structured and very strong. Its extensive root system tends to grow deep up to 4 metre.

9.Sol: Brownian motion is the random motion of particles suspended in a fluid resulting from their collision with the fast-moving molecules in the fluid.

10.Sol: When communication between cells get disrupted then the affected cell chooses to die in multicellular organisms.

11.Sol: A desert cooler cools better on a hot dry day because on a hot dry day temperature is high and humidity is less which helps in better evaporation. Due to the higher rate of evaporation it gives better cooling effect.

12.Sol: Regeneration among hydra occurs as foot regeneration arising from the basal part of the body, and head regeneration, arising from the apical region.

13.Sol: Cod liver oil is highly nutritious, as it can provide 90% of our daily requirements for vitamin A.

14.Sol: The pancreas and glands of intestine release juices containing several enzymes that break down carbohydrates, fats, and proteins in food.

15.Sol: The coelomic fluid of annelids plays a role in many important functions — e . g . , locomotion and regulation of fluid transfer through the body wall.

16.Sol: Cambium is essential for grafting in plants because cambia which consists of meristematic cells of stock and scion fuse together.

17.Sol: An arthropod has a chitinous exoskeleton, haemocoelomic coelom and gills for respiration.

18.Sol: Vitamin E is present in ointments prescribed for burns as they have a faster healing effect.

19.Sol: Kwashiorkor is a form of acute malnutrition that most commonly occurs in children.

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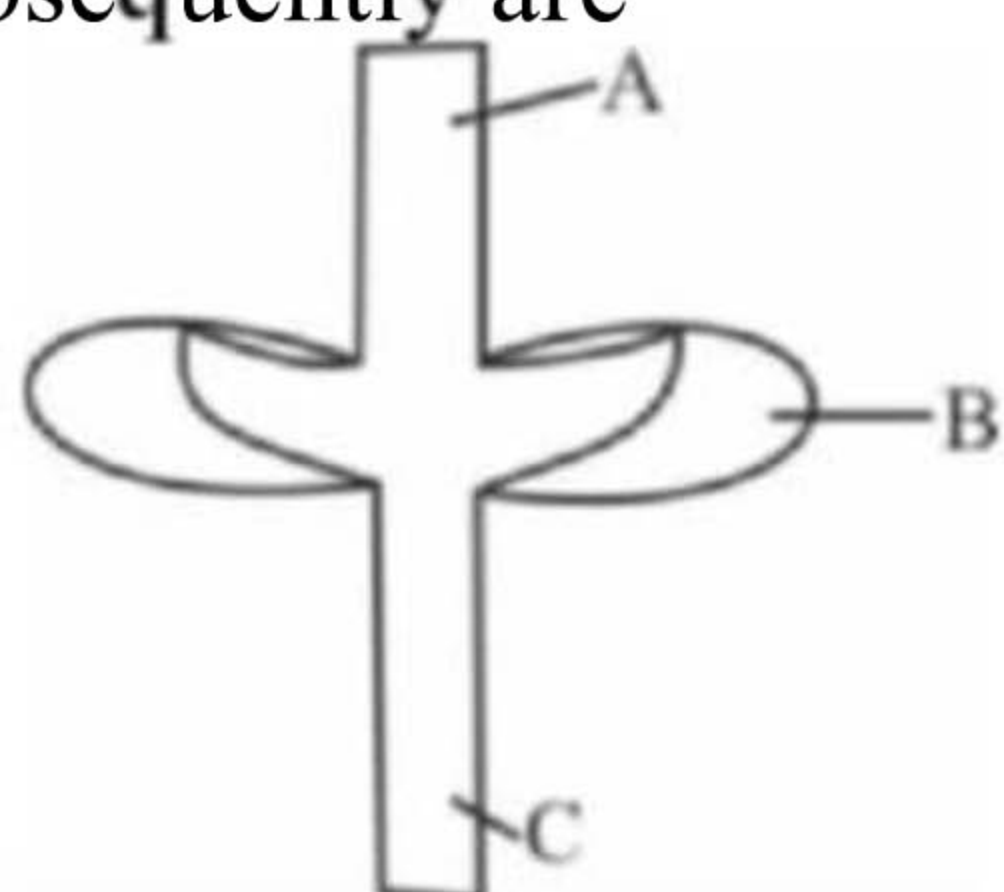


# NTSE

## Reproduction In Organisms

(2018-2019)

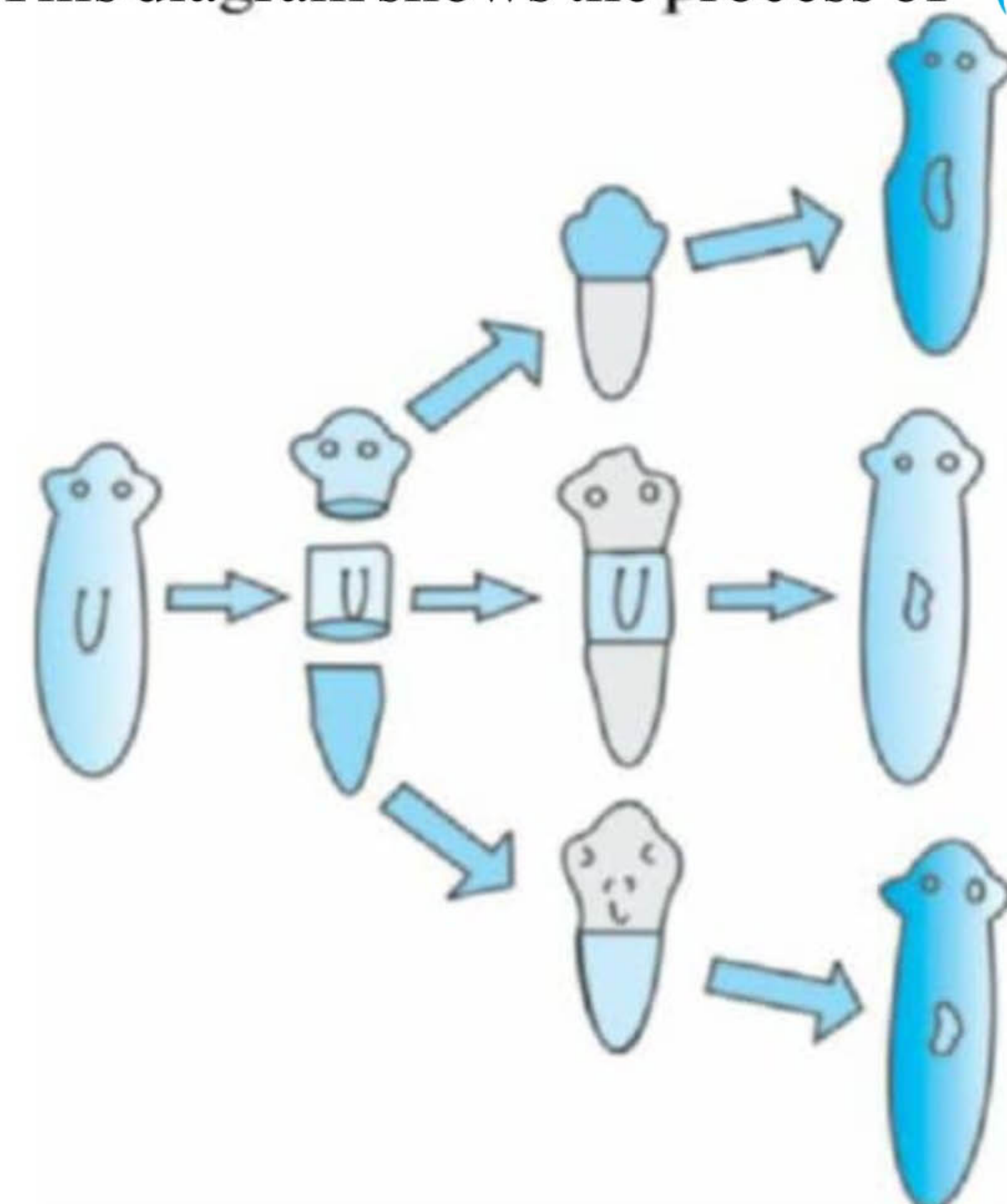
- Name the structure that helps the sperm in penetrating into ovum (Andhra Pradesh)
  - Tail
  - Middle piece
  - Acrosome
  - Neck
- Exchange of genetic material takes place in (Goa)
  - Vegetative reproduction
  - Asexual reproduction
  - Sexual reproduction
  - Budding
- Cessation of menstrual cycle is called (Haryana)
  - Puberty
  - Menarche
  - Pregnancy
  - Menopause
- If the embryonic cells are divided into two groups 8 days after the zygote formation then there is high possibility of formation of (Maharashtra)
  - genetically different twin girls
  - siamese twins
  - genetically different twin boys
  - genetically different one boy one girl
- Number of male gametes in the growing pollen tube is (Rajasthan)
  - one
  - two
  - three
  - seven
- Which of the following is not a secondary reproductive organ? (Rajasthan)
  - Fallopian tube
  - Uterus
  - Ovary
  - Vagina
- Which of the following is the correct sequence of events of sexual reproduction in a flower? (Telangana)
  - Pollination, Fertilisation, Seedling, Embryo
  - Seedling, Embryo, Fertilisation, Pollination
  - Pollination, Fertilisation, Embryo, Seedling
  - Embryo, Seedling, Pollination, Fertilisation
- In the given figure parts marked A, B and C subsequently are (Uttarakhand)



- Cotyledon, plumule and radicle
- Plumule, cotyledon and radicle
- Plumule, radicle and cotyledon
- Radicle, Plumule and cotyledon.

(2017-2018)

- Permanent surgical method for birth control in male human being is ----- (Andhra Pradesh)
  - hysterectomy
  - dialysis
  - tubectomy
  - Vasectomy
- Asexual reproduction takes place through budding in (Bihar)
  - Amoeba
  - Yeast
  - Plasmodium
  - Leishmania
- Which of the following is not a part of the female reproductive system in human beings? (Bihar)
  - Ovary
  - Vas deferens
  - Uterus
  - Fallopian tube
- The anther contains (Bihar)
  - sepals
  - ovules
  - carpel
  - pollen grains.
- Morphologically and genetically similar organism is called (Bihar)
  - clone
  - somaclones
  - corpel
  - cybrids.
- Which one of these is diploid? (Bihar)
  - Egg
  - Pollen
  - Male gamete
  - Zygote
- This diagram shows the process of (Chandigarh)



- binary fission
- multiple fission
- regeneration
- budding.

## ANSWER KEY

- c
- c
- d
- b
- b
- c
- c
- b
- d
- b
- b
- d
- a
- d
- c

## HINTS & SOLUTIONS

- Sol:** The acrosome is filled with enzymes (proteolytic enzymes) that help fertilisation of the ovum. Enzymes secreted by acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. Hence the haploid nucleus of the sperms and that of the ovum fuse together to form a diploid zygote.
- Sol:** The exchange of genetic material occurs during meiosis, that takes place in the gametes of sexually reproducing organisms.
- Sol:** Menopause is the natural decline or ending phase (cessation) of the menstrual cycle.
- Sol:** Siamese twins or conjoint twins develop when an early embryo only partially separates to form two individuals. They are born physically connected to each other and the babies are often attached at the chest, pelvis or buttocks.
- Sol:** Pollen grain when matured it contains two cells, the vegetative cell and generative cell.

When pollen tube is formed, generative cell divides mitotically to give rise to the two male gametes.

**6.Sol:** Ovary is primary reproductive organ in human females.

**7.Sol:** Pollination → Fertilisation → Embryo → Seedling.

**8.Sol:** A- Plumule (part of the seed embryo that develops into the shoot), B- Cotyledon (seed leaf within the embryo of a seed which stores the food for embryo), C- Radicle (part of the seed embryo that develops into root).

**9.Sol:** Vasectomy is a surgical procedure for male sterilization or permanent contraception.

**10.Sol:** Yeast undergoes asexual reproduction by budding. In Budding, small bulb like projection comes out from the yeast cell, which separates from the parental cell at maturity and grows into new yeast cell.

**11.Sol:** Vas deferens, thick-walled tube in the male reproductive system.

**12.Sol:** The anther contains powdery particles called pollen grains.

**13.Sol:** Morphologically and genetically similar organism are called clones.

**14.Sol:** Gametes (sperm cells and egg) are haploid. Haploid gametes fuse to form diploid zygote.

**15.Sol:** Regeneration is the formation of the whole body of an organism from its own small fragment.

## J U Z L E WORDS

### PLANT PHYSIOLOGY

#### SCRAMBLED WORDS

#### CLUES

- SMOSOIS: Diffusion of water across a differentially or semi-permeable membrane.
- RROCZAYMHI: Symbiotic association of a fungus with a root system.
- POHYNICDROS: Growing plants in a nutrient solution
- PERPHOIOSMDI: Response of plants to periods of day/night
- TTGAUONIT: Water loss in its liquid phase
- SIPSMOLSLAY: Cells losing water in a hypertonic solution.
- KICYTOINN: Cell division test in plants
- CHPHYEMROTO: Responsible for flowering
- VNAONERLZAITI: Induction of a plant's flowering process by exposure to prolonged cold treatment
- BIIONIMBIT: A kind of diffusion when water absorbed by solid - colloids causes huge increase in volume

Solutions to the above jumble words will be published in the next issue.



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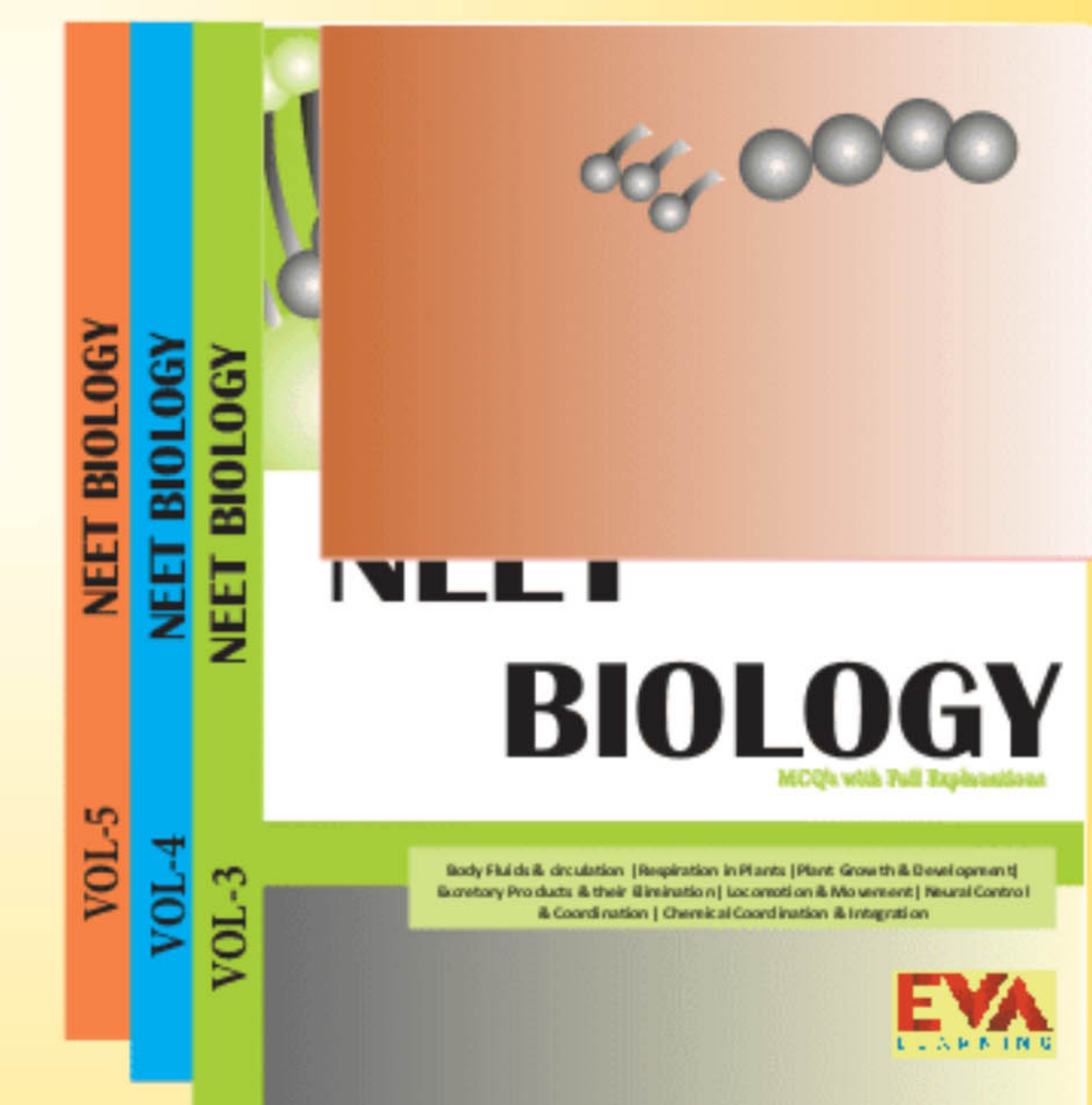
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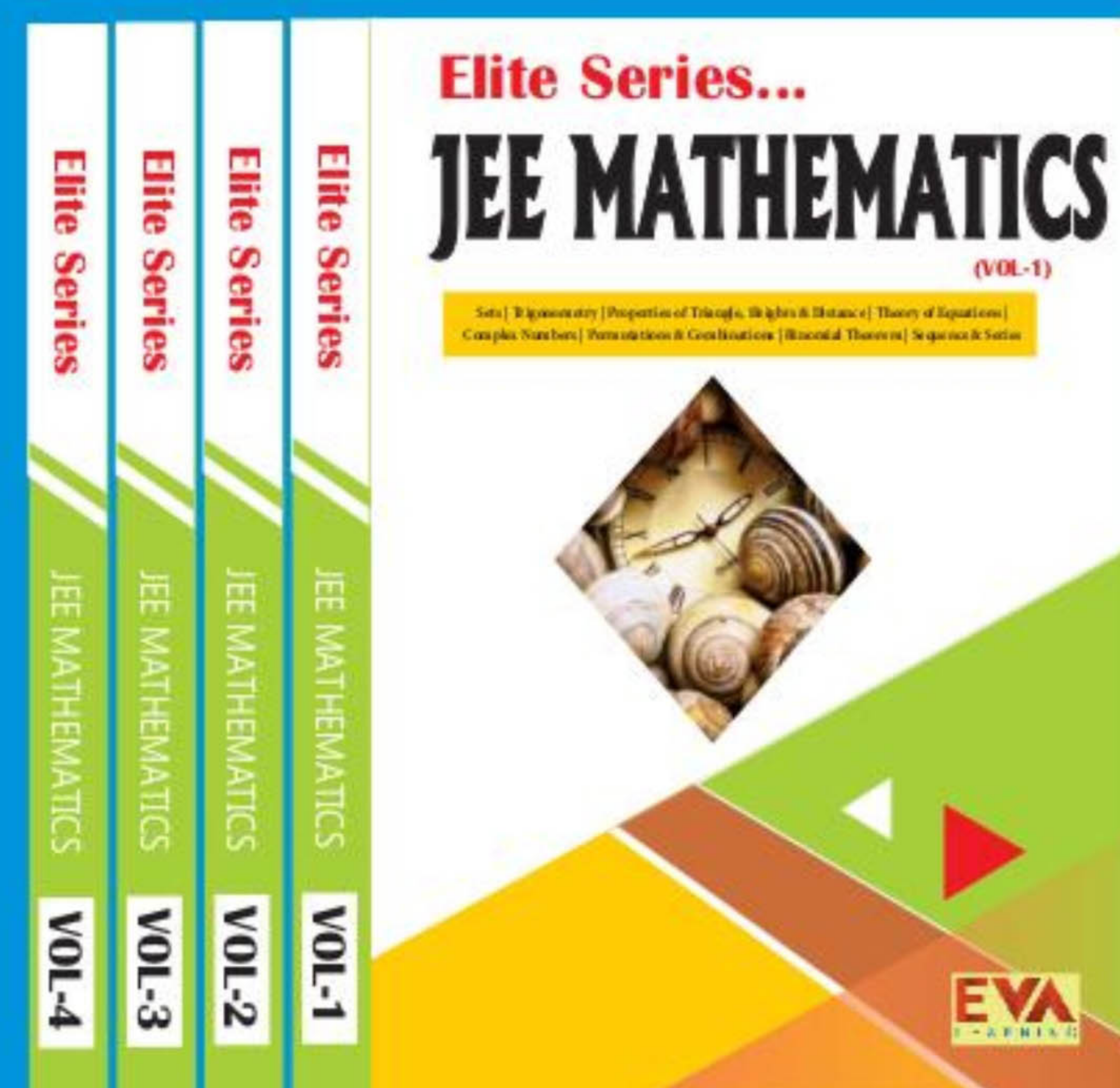
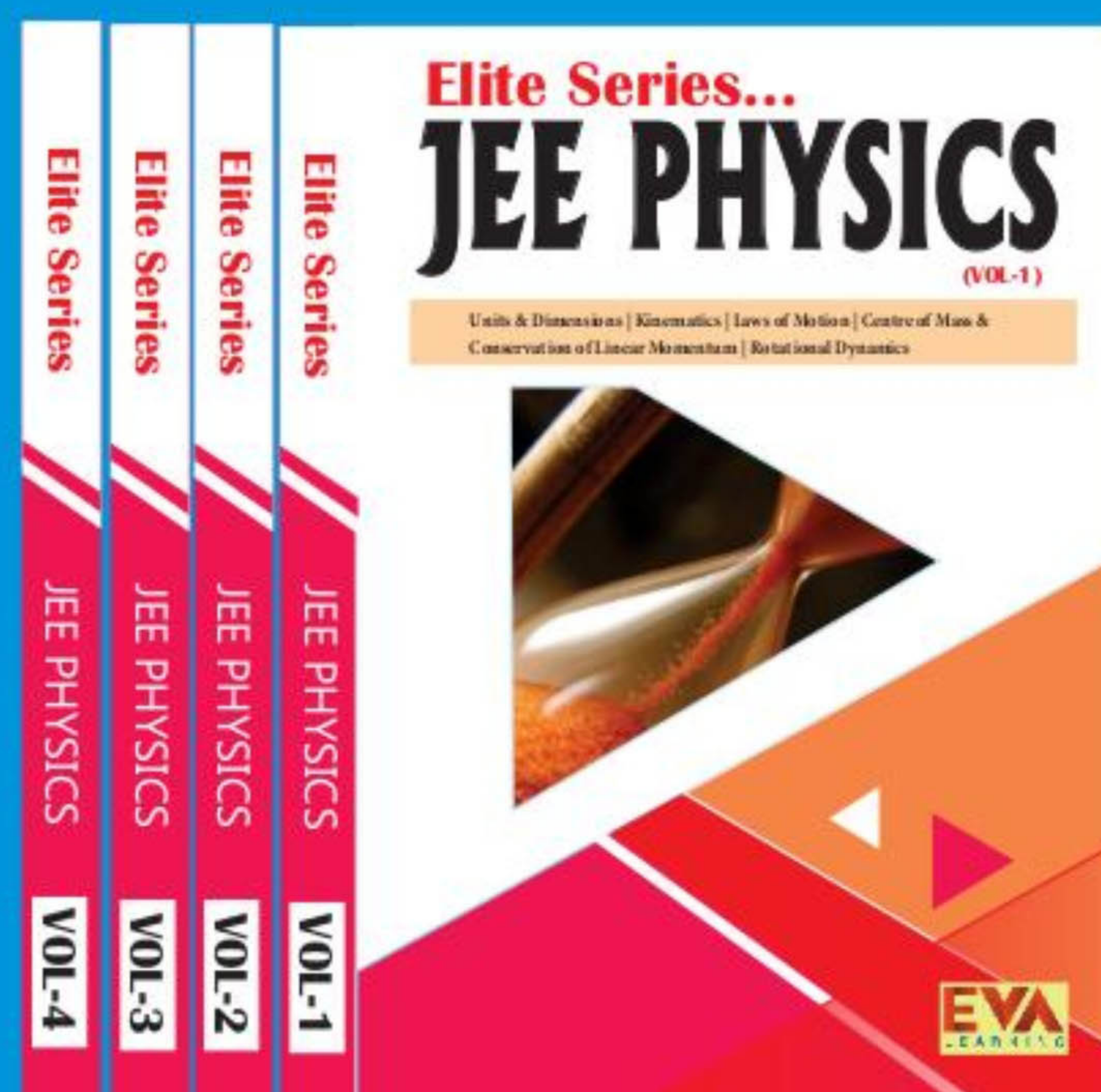
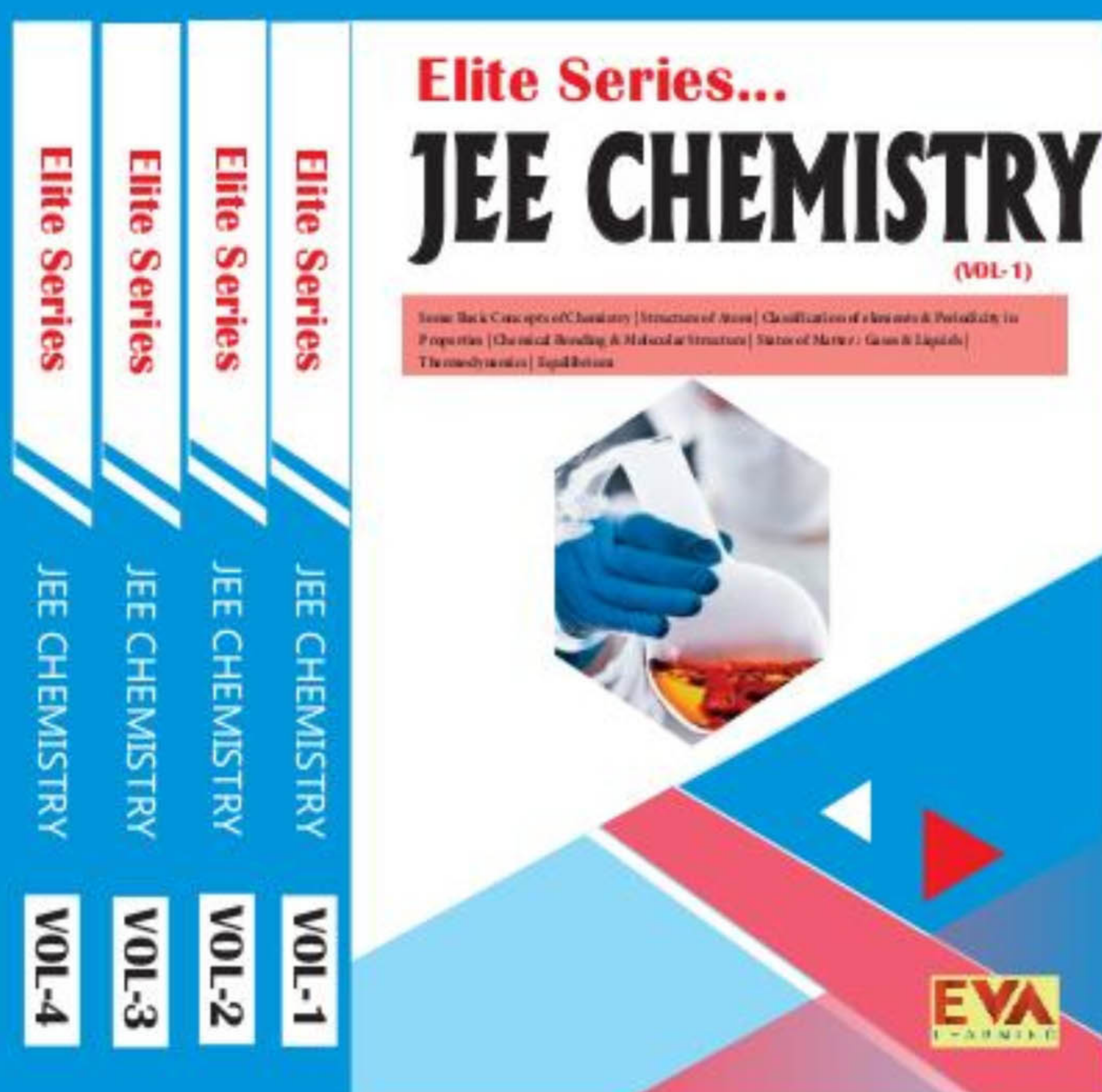


Class XI & XII

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